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A classification of materials handling
information to facilitate equipment selection.

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Purdue University

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A CLASSIFICATION OF MATERIALS
HANDLING INFORMATION
TO FACILITATE EQUIPMENT SELECTION

A Thesis

Submitted to the Faculty

of

Purdue University

by

Horacio Rubens de Mello e Souza

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science in Industrial Engineering

May, 1952

ACKNOWLEDGMENTS

The author wishes to express his great indebtedness to Professor S. Tilles for his guidance, co-operation, and supervision in the preparation of this thesis.

To Professor E. Baumgartner the author is grateful for his suggestions and co-operation.

The author wishes to extend his appreciation to the following companies who supplied invaluable information through their catalogues and literature:

Acme Steel Co.

Aerol Co., Inc.

All Steel Welded Truck Co.

Allis-Chalmers Manufacturing Co.

American Engineering Co.

American Monorail Co.

American Steel & Iron Works

Anchor Steel & Conveyor Co.

Automatic Transportation Co.

The Baker-Raulang Co.

Barber-Greene Co.

Barret-Cravens Co.

The Bassick Co.

Big Joe Manufacturing Co., Inc.

Bigelow-Carvey Lumber Co.

Bond Foundry & Machine Co.

Brainard Steel Co.

18058
+1100

Brummeler Steel Products Corporation
The Buda Co.
The E. W. Dushman Co.
Butler Bin Co.
The Chas. Wm. Doepke Manufacturing Co., Inc.
Chisholm-Moore Hoist Corporation
W. M. Christensen Co., Inc.
Clark Equipment Co.
Cleveland Tramrail Division
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Read Standard Corp.
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Standard Conveyor Co.
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Thomas A. Edison, Inc.

International Paper Company

The Johns Co.

The J. S. Johnson Co.

Kaiser Co.

The Kline Co., Import and Export Co., Inc.

Kleinman-Kohn Co., Inc.

K. S. Kleinman Co., Inc.

Kline Co.

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PREFACE

I was guided by two requirements, when I selected this subject for my thesis work.

Obviously the first requirement was imposed by the University.

"A thesis should be done involving original work and yielding results that might have some usefulness on its particular field."

The second requirement was imposed by myself.

"The subject should be chosen in such a way that the preparation of the thesis will enlarge my knowledge on the field of Industrial Engineering as much as possible."

A thesis done on a very particular problem of the Industrial Engineering field, might well be simpler than a thesis done on a general type of problem, since the former involves fewer variables, and can be presented with more specific results.

An industrial engineer should have a thorough understanding of the whole field of his specialty and a general subject for a thesis may well be more profitable for him than a specific topic in a localized area of research.

The selection of material handling equipment is a very broad problem and research on it involves a complete branch of industry.

Speech

I was invited to the conference, and I accepted
 this subject for my speech.

Obviously the first consideration was raised by the
 necessity.

"A speech should be one involving original work
 and related points that will have some bearing on
 the subject."

The second consideration was raised by myself.
 The subject should be chosen in such a way that the
 presentation of the thesis will require no knowledge on
 the part of the audience, and as much as possible.

A thesis can be a very important problem of the
 industrial revolution, and it will be easier than
 a thesis that is a general type of problem, since the
 former involves more research, and can be presented
 with more authority.

An industrial engineer would have a better chance
 of presenting a thesis of the scientific and technical
 nature for a thesis may well be more difficult for him
 than a thesis topic in a technical area of research.

The selection of material involving research is a
 very broad problem and related to it involves a complete
 course of study.

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Number	Name	Year	Month	Day	Hour	Lat	Long	Alt	Wind	Sea	Weather	Remarks
1	USS Albatross	1892	Jan	1	10	38	122	10	SE	3	Partly Cloudy	Departed
2	USS Albatross	1892	Jan	2	10	38	122	10	SE	3	Partly Cloudy	Departed
3	USS Albatross	1892	Jan	3	10	38	122	10	SE	3	Partly Cloudy	Departed
4	USS Albatross	1892	Jan	4	10	38	122	10	SE	3	Partly Cloudy	Departed
5	USS Albatross	1892	Jan	5	10	38	122	10	SE	3	Partly Cloudy	Departed
6	USS Albatross	1892	Jan	6	10	38	122	10	SE	3	Partly Cloudy	Departed
7	USS Albatross	1892	Jan	7	10	38	122	10	SE	3	Partly Cloudy	Departed
8	USS Albatross	1892	Jan	8	10	38	122	10	SE	3	Partly Cloudy	Departed
9	USS Albatross	1892	Jan	9	10	38	122	10	SE	3	Partly Cloudy	Departed
10	USS Albatross	1892	Jan	10	10	38	122	10	SE	3	Partly Cloudy	Departed
11	USS Albatross	1892	Jan	11	10	38	122	10	SE	3	Partly Cloudy	Departed
12	USS Albatross	1892	Jan	12	10	38	122	10	SE	3	Partly Cloudy	Departed
13	USS Albatross	1892	Jan	13	10	38	122	10	SE	3	Partly Cloudy	Departed
14	USS Albatross	1892	Jan	14	10	38	122	10	SE	3	Partly Cloudy	Departed
15	USS Albatross	1892	Jan	15	10	38	122	10	SE	3	Partly Cloudy	Departed
16	USS Albatross	1892	Jan	16	10	38	122	10	SE	3	Partly Cloudy	Departed
17	USS Albatross	1892	Jan	17	10	38	122	10	SE	3	Partly Cloudy	Departed
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23	USS Albatross	1892	Jan	23	10	38	122	10	SE	3	Partly Cloudy	Departed
24	USS Albatross	1892	Jan	24	10	38	122	10	SE	3	Partly Cloudy	Departed
25	USS Albatross	1892	Jan	25	10	38	122	10	SE	3	Partly Cloudy	Departed
26	USS Albatross	1892	Jan	26	10	38	122	10	SE	3	Partly Cloudy	Departed
27	USS Albatross	1892	Jan	27	10	38	122	10	SE	3	Partly Cloudy	Departed
28	USS Albatross	1892	Jan	28	10	38	122	10	SE	3	Partly Cloudy	Departed
29	USS Albatross	1892	Jan	29	10	38	122	10	SE	3	Partly Cloudy	Departed
30	USS Albatross	1892	Jan	30	10	38	122	10	SE	3	Partly Cloudy	Departed

ABSTRACT

The purpose of this thesis is to classify material handling information available from books, pamphlets, or magazines, to collect that information, and to present it in a compact form to facilitate selection of equipment for a material handling problem.

This classification is made according to movement required, type of load, and purposes of the transportation.

Equipment, movements, loads, and the purposes of handling were classified separately, and then assembled together in a table, where each type of equipment is analyzed according to these criteria.

173 cases were surveyed and each case was represented by an entry in the table, indicating what class of equipment was used, what movements were performed, what load was transported and what the purposes of that handling were.

The number of times each type of equipment was used in a particular set of circumstances was obtained, and percentages were computed. A final table was prepared to summarize the findings. This table represents the relationship between equipment and its use, in the cases analyzed.

APPENDIX

The purpose of this study is to identify and
 establish information available from books, periodicals, or
 magazines, to collect their information, and to present
 it in a compact form by utilizing selected 25 subjects
 for a critical analysis.

This dissertation is now being so revised
 regarding the 25 subjects, and subject of the experimental
 equipment, apparatus, tools, and the purpose of
 location and classification respectively and then arranged
 together in a table, where each type of equipment is
 classified according to these criteria.

The work was covered the work was completed
 by an entry in the table, including your class of equip-
 ment and type, with equipment with location, that tool
 was transferred and with the purpose of that working
 was.

The number of items and type of equipment was given
 in a separate set of statements as outlined, and
 presented with equipment. A final table was prepared by
 summarizing the findings. This table represents the 25-
 percent of equipment and its use. In the table
 equipment.

PROCEDURE

The survey of the literature was my first concern.

Books and magazines from the Purdue Libraries, and catalogues obtained upon request to about fifty manufacturers of material handling equipment, were the sources of information.

One month was spent in readings only. The classifications and the accumulation of data were not started until the end of that first period.

After the first set of classifications was issued, the method of investigation could be designed. Since the literature on material handling cases is not uniform in the type and detail of information it provides, one must be acquainted with it before starting to put it to use.

The tables in appendix A, represent the final form developed from several preliminary trials. Most of the articles were read more than once to take care of differences in the ways of collecting data.

It would be nice if all the information could be collected in numerical form, but this was not possible; so classifications of "large", "medium", and "small" were made up, and these are defined.

Distances and weights, when not directly given, were estimated from graphs or photographs. Average densities of materials were often used to obtain the weights. The size of workers, when included in photographs, was assumed as 6 feet and used for height determinations.

SURVEY OF LITERATURE

I. Definition of Materials Handling

Concept of Material Handling. What material handling means to people in industry was my first concern when I started this work.

The following are some definitions presented by well-known authors.

Koshkin: (1) Material handling may be defined as follows: It is the horizontal or vertical movement, or a combination of these, or the picking up and setting down, of all materials, whether in their raw, semi-finished, or completely finished form.

Piacetelli: (2) Handling materials is picking up and putting down, moving in a horizontal or vertical plane, or both, by any means, materials or products of any kind in their raw, semi-finished, or completely finished condition.

Stocker: (3) Material handling is generally defined as the handling of raw materials; semi-finished materials and parts; finished products in packages like boxes, cartons, barrels or in bulk through production and storage

1 - Koshkin, S. J., Modern Materials Handling; New York, John Wiley & Sons, Inc., 1932, p. 12.

2 - Production Handbook; New York, The Ronald Press Co., 1947, p. 935.

3.- Stocker, H. E., Materials Handling; New York, Prentice Hall, Inc., 1951, p. 1.

II. Definition of "Public Health"

Concept of "Public Health". The concept of "Public Health" is defined as the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community. It is the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community.

(1) The concept of "Public Health" is defined as the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community. It is the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community.

(2) The concept of "Public Health" is defined as the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community. It is the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community.

(3) The concept of "Public Health" is defined as the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community. It is the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community.

(4) The concept of "Public Health" is defined as the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community. It is the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community.

(5) The concept of "Public Health" is defined as the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community. It is the science and art of preventing disease, prolonging life, and promoting the physical, mental, and social well-being of the community.

areas within a plant. All material handling is transportation and all transportation is material handling.

Potts: (4) Material Handling is the lifting, shifting, and placing of any material, regardless of its size, form, or weight.

Barker: (5) Materials handling is the picking up and putting down, moving of materials or products in any plane or combination of planes, by any means, which includes storage and all movements except processing operations and consumption or end of the material.

Wharen: (6) Materials handling is transportation of all materials into and through a plant, through manufacturing processes, assembly, stores and shipping. It is, however, more than transportation in the commonly accepted definition of carrying or moving materials from one place to another in a horizontal plane. It includes lifting, moving, tiering and stacking. It is the pipeline of production.

From GE 186 the following definition was accepted after a period of discussions.

- - - - -
4 - Potts, M. W., Materials Handling Equipment; New York, Pitman Publishing Corp., 1946, p. 1.

5 - Barker, C. H., Footlick, I. M., Yarham, C. F., Carle, J. F., Industrial Materials Handling; Cleveland, Ohio, The Lincoln Extension Institute, Inc., 1950, p. 5.

6 - Wharen, H. S., "Modern Materials-Handling Methods," American Machinist, June 20, 1946, p. 109-140.

cross within a circle. All material handling is done
done and all transportation is by road.
The material handling is by road, and
and clearing of the material, especially of the
in water.

Notes: (1) Material handling is the main part of
material work, and of material or material in any case
no material of material, or any other, which is
material and all material work, material work
and material work of the material.

Notes: (2) Material handling is the main part of
all material work and material work, material work
material work, material work, material work, material
material, and then material work in the material work
material of material or material work, material work
in material in a material work. It is the material work
material, material work, material work. It is the material work
material.

Notes: (3) Material work, material work, material work
after a period of material work.

Notes: (4) Material work, material work, material work
Notes: (5) Material work, material work, material work
Notes: (6) Material work, material work, material work
Notes: (7) Material work, material work, material work
Notes: (8) Material work, material work, material work
Notes: (9) Material work, material work, material work
Notes: (10) Material work, material work, material work

Each time the material is lifted, laid down, piled or unplied, loaded or unloaded, transported vertically or horizontally from one position to another, placed or moved from storage, or moved in any way whatever it undergoes "handling". There are specific instances where movement in a machine should be included, as in drying equipment, but these exceptions should be explicitly noted.

As can be observed, there is a tendency to include storage in these considerations; however the point is not generally accepted. My point of view is that storage should be included since modern material handling equipment has been designed to improve the storage function as well as handling in general.

II. Importance of Materials Handling

Another point to be considered is how important material handling is. The opinions of material handling authorities give no significant proof in themselves of the importance of this subject. They, too, have to "sell" their ideas. However, statistical surveys have shown that an average of 40% or more of the cost of a product is spent in handling operations. (7, 8, 9, 10, 11, 12)

7 - Sarder, D. S., "Cut Costs: Push Material Handling," Iron Age, vol. 168, October 18, 1951, p. 81.

8 - Urquhart, L. R., Boyce, C. W., The Materials Handling Case Book; New York, McGraw-Hill Book Co., 1951, p. 3 and 89.

[illegible][illegible]

McClelland (13), talking about the executive in charge of material handling, compared his functions with the functions of the production manager, and proposed that both should be located in the same echelon on an industry's organization chart. As he said: "If the two functions, handling and production, represent comparable costs it seems logical to ponder the possibility of some such breakdown of assignments".

Safety plays an important role in the field of materials handling (14). Surveys (15) show that approximately 40% of plant accidents involve the materials handling operations within the plant.

A team of selected British Engineers visiting American Industry to study the circumstances which have led to the wide application of material handling equipment, ex-

- - - - -

9 - Production Handbook; New York, The Ronald Press Co., 1947, p. 936.

10- Stocker, H. E., Materials Handling; New York, Prentice Hall, Inc., 1951, p. 3.

11- Barker, C. H., Footlik, I. M., Yarham, C. F., Carle, J. P., Industrial Materials Handling; Cleveland, Ohio, The Lincoln Extension Institute, Inc., 1950, p. 13.

12- Mallick, R. W., Gaudreau, A. T., Plant Layout; New York, John Wiley & Sons, Inc., 1951, p. 182.

13- McClelland, W. B., Joint Navy-Air Force Packaging and Materials Handling Seminar; Battle Creek, Michigan, Industrial Truck Division, Clark Equipment Co., 1950, p. 3.

14- Loughrey, D. J., "Material Handling for a Modern Open Hearth Furnace Plant," Blast Furnace & Steel, vol. 39, October 1951, p. 1211.

15- Urquhart, L. K., Boyce, C. W., The Materials Handling Case Book; New York, McGraw-Hill Book Co., 1951, p. 89.

pressed themselves with the words: (16)

"Our American friends tell us that the cost of production and distribution is directly related to their standard of living and they regard materials handling as one of the major factors affecting the cost of living.

Better materials handling offers a greater opportunity to cut production costs and to increase productivity than any other single factor. In the U. S. factories that we visited, this conviction was shared by top management and all grades of employees, and was given full consideration in every decision relating to manufacturing methods and practice."

Articles written on the matter, commonly emphasize the fact that a large percentage of present industry is not aware of the full advantages offered by a careful analysis of its material handling installations. Again this may be considered as "selling" propaganda, instead of a lack of knowledge of industrial executives.

The opinion of the British committee and the increasing investments in material handling equipment, at least, are two good reasons to reject that idea.

A doubtful point, found throughout the literature is the question of whether handling alone increases the value of some product.

- - - - -

16- Anglo-American Council on Productivity, Materials Handling in Industry; London, New York, 1950, p. 5 and 9.

unusual phenomena with the world (15)

"Our American friends will be glad to hear of progress and distribution is directly related to their standard of living and they regard material conditions as one of the major factors affecting the rate of living.

Further material conditions affect a greater opportunity for our production costs and the increase productivity than any other single factor. In the U. S. statistics that are related, this conclusion was reached by the management and all types of employees. And has given full consideration in every decision relating to manufacturing methods and products."

Statistics collected on the matter, commonly known as the fact that a large percentage of present industry is not aware of the full advantages offered by a careful analysis of the material handling facilities. Again this may be considered as "selling" machinery, instead of a loss of knowledge of industrial necessities. The opinion of the British Committee and the increase in investments in material handling equipment, at least, are two good reasons to reject that idea.

A general point, which encompasses the literature in the question of material handling also involves the value of some products.

General in Industry, London, New York, 1960, p. 5 and 6.
The American Council on Productivity, 1960.

Stocker (17) mentions this fact by writing:

"...However, it is not true, as has been so often said, that materials handling adds to cost but not to value.

A machine will convert a piece of bar steel into railroad spikes but the spikes will have no value at the machine. They must be handled from the machine to a warehouse, railroad car, or motor truck, and so on until they are delivered to someone who will pay for them where he wants them. Therefore, it might be argued that only materials handling creates value because it takes material from where they have no value to a point where they have value. The economists call this "place-utility value".

Approaching the matter realistically, both the machine work and materials handling are necessary to provide a product that people will pay for.

III. Current Trends in Materials Handling

One weak point of the present status of materials handling is related to the question of evaluation of a given system. The problem involves so many variables that a complete analysis of it would perhaps cost more than the advantages of a complete answer would save. Cost analysis (18, 19) is usually done for very particular cases and

- - - - -

17- Stocker, H. E., Materials Handling; New York, Prentice Hall, Inc., 1951, p. 4.

18- McClelland, W. B., Joint Navy-Air Force Packaging and Materials Handling Seminar; Battle Creek, Michigan, Industrial Truck Division, Clark Equipment Co., 1950, p. 13.

"...however, it is not true, as has been so often said, that material handling costs are not part of value. A machine will convert a piece of raw steel into a good article but the process will have no value at all in itself. They must be derived from the machine as a whole, machine, railroad car, or motor truck, and so on until they are delivered to someone who will pay for them. Hence the value of a machine, therefore, is not in itself only material handling costs as value because it takes material from where they have no value to a point where they have value. The economists call this "value-adding value." Examining the value-adding process, both the machine work and material handling are necessary to produce a product that would sell for.

III. Current trends in material handling

One main point of the present review of material handling is related to the question of valuation of a given system. The problem involved is more complex than a simple analysis of its small parts and more than the advantages of a complete system would show. Cost analysis (12, 13) is usually done for very complicated cases and

IV. Speaker 1178 continued with that of yesterday
 Will, Jan., 1911, p. 11.

IV. Speaker 1179 continued with that of yesterday
 Material Handling Systems, Ellis Green, Chicago, Illinois, 1910, p. 11.

the most we get is an approximation of the complete solution.

Besides the great number of variables, the fact that handling operations are well mixed with other productive operations, makes the problem yet more complex.

The new "Operations Research" techniques might be the answer for this particular problem, as well as for many other equally important industrial questions.

Mechanization. "Mechanize whatever you can", is a common saying in most articles.

The high rates of pay for man-work and the constant improvement of production machines, always demanding a greater input of materials, are perhaps the two most important reasons for the present trend of mechanization in the material handling field.

The use of mechanized equipment, with load capacities far above the classical "wheelbarrow", obviously increased the economical "load size".

Volumes piled up in large lots require more time to load or unload from a given place, unless they are packed together forming one unit. This is the origin of the so-called "unit load principle" widely recognized through the field.

The assembling of unit loads in pallets, in strapped bundles, or any type of container, is of primary concern to people engaged in handling operations.

- - - - -
19- Day, J. B., Material Handling Engineering; School of Industrial Engineering, Georgia Institute of Technology, 1950, chapter II.

the most we get is an approximation of the original material. Besides the great number of varieties the last time handling operations are still mixed with other products.

The new "American Revolution" movement, which is the
essence of the "American Revolution" movement, is a very
important movement in the history of the United States.

1. Investigation - The investigation is the first step in the process of identifying and understanding the problem. It involves gathering information about the problem, its causes, and its effects. This information is then used to develop a plan of action.

The high value of my for has been the primary
purpose of this study. After several
years of study, the results are now in
the hands of the public and are available in
the public domain.

The use of mechanical equipment, with load velocities
let above the classical "weibull" & obviously increased
the mechanical "load" time.

Witness called up in Jersey 1442 twenty were taken to
land up raised from a ship, which they are passed
passing looking for help. This is the price of the sea-
sailed "the loss of the ship" which was recognized through the
time.

The following of only leads in which, in response
 finished, on any type of material, in an attempt to
 to make a record of working material.

[illegible]

Intraplant distances are not large in comparison with road distances, and the overall efficiency of each operation depends less upon the travel speed than upon the speed with which the material can be picked up, stacked, and set down.

The "unit load principle" of material handling is distinguished by the fact that it contains within itself the means of picking up, stacking and setting down, as well as carrying or handling the material.

The enormous use of the well-known fork lift truck (20) is a function of these basic considerations. Also conveyerization follows the same pattern. Here the elimination of many loading or unloading operations may be the aim.

One interesting fact observed by comparing materials handling literature written more than twenty years ago, (21, 22, 23) with modern books and articles, was this present trend toward mechanization, not only of the transportations, but also of the handling between transportations. Old books describe types of trucks, cranes, or conveyors that are still

- - - - -

20- "They Pick 'em Up and Lay 'em Down", Time, May 14 1951, p. 106-2.

21- Koshkin, S. J., Modern Materials Handling; New York, John Wiley & Sons, Inc., 1932.

22- Wright, R. V., Little, J. G., Augur, R. C., Material Handling Encyclopedia, New York, Simmons-Boardman Publishing Co., 1921.

23- Zimmer, G. F., The Mechanical Handling & Storing of Material, London, The Technical Press Ltd., 1932.

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in use; technical improvements have changed their details, but the general form is the same. However these old books have very little to say about high lift trucks, positioning devices, (24) scales strategically located and an infinity of special mechanisms widely used today.

Coordination. The second large trend for modern industries, is characterized by a tendency to coordinate handling operations between plants. Mutual savings and benefits are evident. Steel strapping and standard pallets are typical examples of these coordination plans. (25)

No Lay-off. A primary consideration observed in most of the cases where savings in man hours are introduced by new methods, is the utilization of excess workers in some other part of the plant. This procedure was mentioned in about 100% of the articles.

- - - - -
24- "What Equipment for Positioning," Flow, vol. 7, no. 6, March 1952, p. 59-63.

25- Material Handling Institute, Inc., Modern Methods of Materials Handling; New York, Prentice-Hall, Inc., 1951, p. 51, 52, 55.

CLASSIFICATION OF EQUIPMENT

I. Basic Considerations

As Koshkin (26) pointed out, "it is not very easy to properly classify materials-handling equipment, as at least three points of view may be considered as predominant, namely: the machine itself, the material handled, or the service."

The following classification is based on machines. It was felt that this criterion of separation would simplify the whole classification, since materials and services taken alone, are not necessarily good indications of the complete problem.

If it is known, for instance, that so many boards of lumber have to be moved daily, very little is known of the problem. Distances, geographical conditions, and purposes of the transportation are so important that the final solution might be entirely affected by them. The same conveyor used in a warehouse to handle miscellaneous articles might be used in a hospital to handle paralysis patients from bed to pool for swim treatment. (27)

This classification was specially designed for use as a basis of the quantitative survey; presented in the next section.

26- Koshkin, S. J., Modern Materials Handling; New York, John Wiley & Sons, Inc., 1932, p. 6.

27- American Monorail Catalogue D; Cleveland, Ohio, 1950, p. 40.

The definitions that follow the classification were included to standardize the nomenclature used specifically in this work. They are not necessarily intended as general recommendations.

II. General Classification of Equipment

Four main groups were chosen:

1. Industrial Trucks
2. Conveyors
3. Cranes
4. Miscellaneous

1. Industrial Trucks

Hand Trucks

- a. No lift hand trucks
- b. Lift hand trucks

Powered Trucks

- c. No lift power trucks
- d. Low lift power trucks
- e. High lift power trucks
- f. Tractor-trailer trucks
- g. Special power trucks

2. Conveyors

- a. Roller conveyors
- b. Wheel conveyors
- c. Chutes
- d. Belt conveyors
- e. Apron conveyors
- f. Pusher bar conveyors

The committee has also been instructed to include in its report the names of the persons who have been in this work, and who are necessary to be included in the report.

II. General description of the work

The work has been done in the following manner:

1. General description of the work

2. General description of the work

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- g. Bucket conveyors
- h. Independent track carriers
- i. Chain conveyors
- j. Platform elevators
- k. Portable conveyors
- l. Special conveyors

3. Cranes

- a. Bridge cranes
- b. Boom cranes
- c. Jib cranes
- d. Fixed position hoists
- e. Portable cranes

4. Miscellaneous

III. Definitions

This section was included to specify exactly the meaning of terms used. The lack of uniformity of the nomenclature in this field is a matter of deplorable fact.

An attempt was made to follow the concepts of authors like Koshkin, Stocker, Footlick, and others, and pictures and definitions from manufacturer's catalogues.

Material Handling Equipment is that equipment designed to provide a means to change the location of a given load, to prepare the load for this change, or to secure the load after or before the required change.

These functions may be classified as:

Transportation

Picking up or setting down

Storaging

Packing, strapping, and other

1. Local computers
2. Portable computers
3. Dedicated servers
4. Main computers
5. Interconnected with various
6. Local computers

1007

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into the title is a matter of linguistic fact. The lack of uniformity of the nomenclature of terms used. The fact of uniformity of the nomenclature. This section was included to readily identify the user.

and definitions for management's actions.

Special Training Equipment is that equipment designed to provide a means to change the location of a class room, to prepare the room for this change, or to remove the load thereon or before the removal thereof.

The following definitions are based on these basic considerations.

1. Industrial Trucks. (28) Basically speaking they are platforms on trackless wheels. Their main function is transportation, which is done in a plane parallel to the floor. Some types of trucks have provisions for picking up or setting down loads.

Hand Trucks (Fig. 1 and 2) are industrial trucks moved by human force only. If there are not devices for picking up the load or setting it down, the truck may be designated as "no lift". If the platform is commonly introduced under the load and an elevating mechanism provides a small clearance to raise the load supporters from the floor, then the truck may be designated as "lift".

Powered Trucks (Fig. 3 to 7) are self-propelled industrial trucks. The "no lift" and "low lift" types are similar to the "no lift" and "lift" types, already described as "Hand Trucks". The source of energy is evidently the basis for differentiation. "High lift" trucks are trucks equipped to pick up the load and set it down from or to places not necessarily at floor level.

"Tractor trailer" systems are a chain of trailers (similar to "no lift hand trucks") pulled by a truck which has as its only purpose to haul the train formed in this manner.

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28- The Electric Industrial Truck Association, Handbook of Material Handling with Industrial Trucks; Philadelphia, The Electric Industrial Truck Association, 1950.

The group "special power trucks" is devoted to trucks with devices other than those already mentioned.

2. Conveyors (29, 30, 31) are path providers. Their main function is to transport the load in a fixed and definite way. However, intentional storage during transportation is often made.

The class of conveyors may be said to comprise all track systems and their respective carriers. Conveyors allow for a reasonable separation of the load; therefore, many operations, besides single transportation, might be performed to the individual parts of the load.

Roller and Wheel Conveyors (Fig. 8 and 9) are characterized by having rollers or wheels mounted on shafts perpendicular to the direction of the motion of the load. Gravity is usually the force used to move the load.

Chutes (Fig. 10) may be defined as being a continuous and smooth fixed platform. Gravity is the only force employed to move the load.

Belt Conveyors (Fig. 11) are characterized by a continuous and flexible movable platform.

Apron Conveyors (Fig. 12) are characterized by a not-

29- Cooke, J. L., "Materials Handling Equipment," Ice & Refrigeration, vol. 121, no. 1, July 1951, p. 11.

30- Darling, F. E., "Traveling Stockrooms Assure Flexible Assembly," Factory Management & Maintenance, vol. 103, no. 9, September 1950, p. 54-7.

31- Hetzel, F. V., Albright, R. K., Belt Conveyors and Belt Elevators; New York, John Wiley & Sons, Inc., 1941.

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2. Letters (No. 51) are also numbered. Their date
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continuous, but flexible platform. They could be considered as a special case of a belt conveyor.

Pusher Bar (Fig. 13). The basic type is characterized by moving bars that transmit motion to the load.

Bucket (Fig. 14). A continuous chain of hinged buckets.

Independent Track Carriers (Fig. 15). This type is characterized by one or more carriers running on tracks which may be installed in either the floor or overhead. Human effort or independent power units are used for propulsion.

Chain (Fig. 16). This type is basically the same as above, but all the carriers are mechanically connected. A continuous and movable chain provides the force, or the force and the path, for the motion. The former case is represented by chain conveyors in which the load hangs directly from the links; the latter refers to a chain used in conjunction with separate carriers running on tracks or directly on the floor.

Platform Elevators (Fig. 17) are conveyors specially designed to lift or to lower the load; therefore, vertical paths are widely used.

Portable (Fig. 18). Any type of conveyor mounted on wheels to facilitate its transportation to several points of the plant.

Special. Any type of conveyor not covered in the above list of conveyors.

3. Cranes (32) are units designed to pick up a given load

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32- Wolverhampton, R. B., "Hook Handlers Simplify Heavy Lifts," American Machinist, vol. 93, no. 24, Dec. 1, 1949, p. 86-7.

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*reperio: find a book, discover a new product

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and to change its location while holding it in the air. Transportation is not the primary purpose, since they are most used to load or unload other classes of equipment. Different types of mechanisms and supporting structures characterize the various types of cranes. These are:

Bridge or Gantry (Fig. 20). Here the lifting mechanism is supported by a bridge which is supported by a parallel pair of tracks. The bridge moves along the tracks and the hoisting unit moves along the bridge.

Boom (Fig. 21). The lifting unit is supported at the end of a boom, which is basically a bar with one fixed point, like the barrel of a naval gun. Mechanisms for rotation around a vertical axis, a horizontal axis, or both, should be provided.

Derrick or Pillar cranes may be included in this group, since they have the same basic characteristics. A pillar or mast is used to support the boom, but the boom is still there to perform the same motions.

Jib (Fig. 22). An inverted rigid "L" is the basic frame of a jib crane. The hoisting unit is located at the end of the overhanging arm, and it may or may not slide along the arm. The whole frame rotates around a vertical axis. (Fixed frames with sliding hoists were classified as conveyors).

Fixed Position Hoists (Fig. 23) are powered or manual hoists, hung or attached to some overhead point. They provide vertical motion only.

Portable (Fig. 24). Any of the above groups are con-

and to space the location while holding it in the air.
 Transportation is not the primary purpose, since that can
 most often be done by means of other classes of equipment.
 Different types of mechanisms and supporting structures
 characterize the various types of cranes. These are

Bridge or gantry (Fig. 10). Here the lifting mechanism

is supported by a bridge which is supported by a pair
 of rails. The bridge moves along the rails
 and the hoisting unit moves along the bridge.

Boom (Fig. 11). The lifting unit is supported at the

end of a boom, which is usually a bar with one fixed point,
 and the barrel of a reel drum. Mechanisms for rotation
 around a vertical axis, a horizontal axis, or both, should
 be provided.

Carrier or trolley cranes may be included in this group.

These have the same basic characteristics. A carrier
 or trolley is used to support the boom, but the boom is still
 able to perform the same motions.

Hoist (Fig. 12). An inverted trolley is the carrier

of a hoist. The hoisting unit is located at the
 end of the supporting arm, and it may or may not move along
 the arm. The hoist frame rotates around a vertical axis.
 (Fixed frames with lifting devices were classified as gantry
 cranes.)

Fixed position cranes (Fig. 13) are powered by manual

hoists, and are attached to some overhead point. They are
 of the vertical action type.

Portable (Fig. 14). Any of the above groups are con-

sidered portable when the whole structure can be transported to different points in a plant. Wheels, crawlers or pontoons may be employed for that purpose.

Miscellaneous. Any other material handling equipment that was not covered in the previously described classes. As pointed out before, this classification was designed for the specific purpose of selection of material handling equipment, and from most of the cases that were studied, the above divisions were considered sufficient.

already pointed out when the whole specimen was in the laboratory to different points in a glass. These, however, are of some

importance. For after material is in the laboratory, it is not always in the position in which it is described in the literature. As pointed out before, this classification was designed for the specific purpose of selection of material for study, and from most of the cases that were studied, the above divisions were considered sufficient.

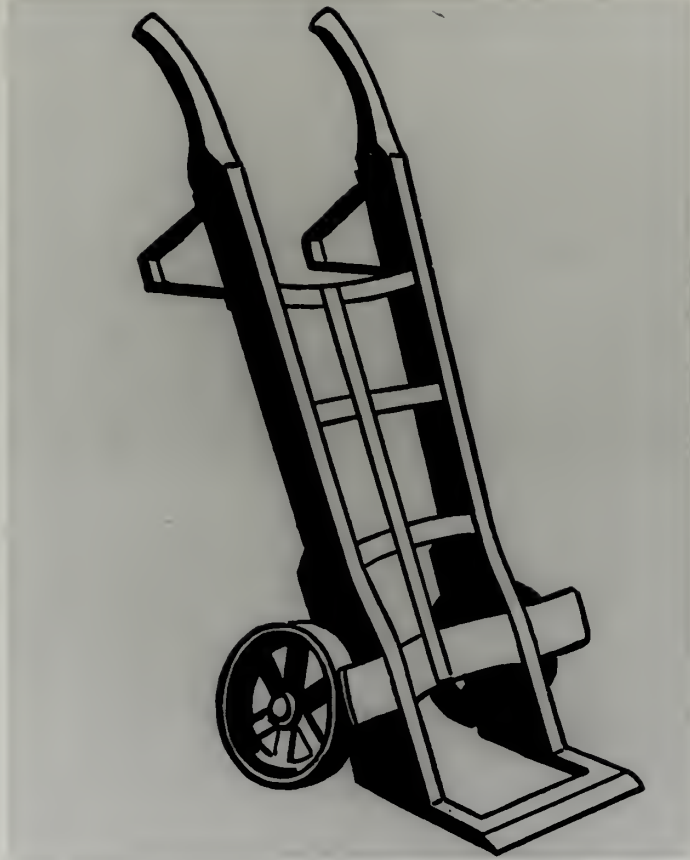


Fig. 1 No Lift Hand Truck

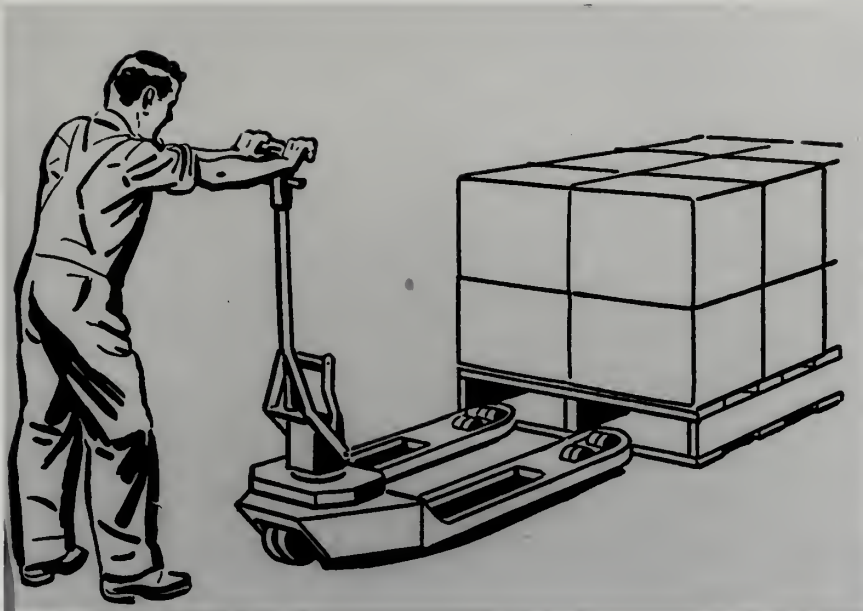


Fig. 2 Lift Hand Truck



Fig. 1. The first series of experiments.



Fig. 2. The second series of experiments.



Fig. 3 No Lift Power Truck



Fig. 4 Low Lift Power Truck



Fig. 3. The left hand view.



Fig. 4. The right hand view.



Fig. 5 High Lift Power Truck

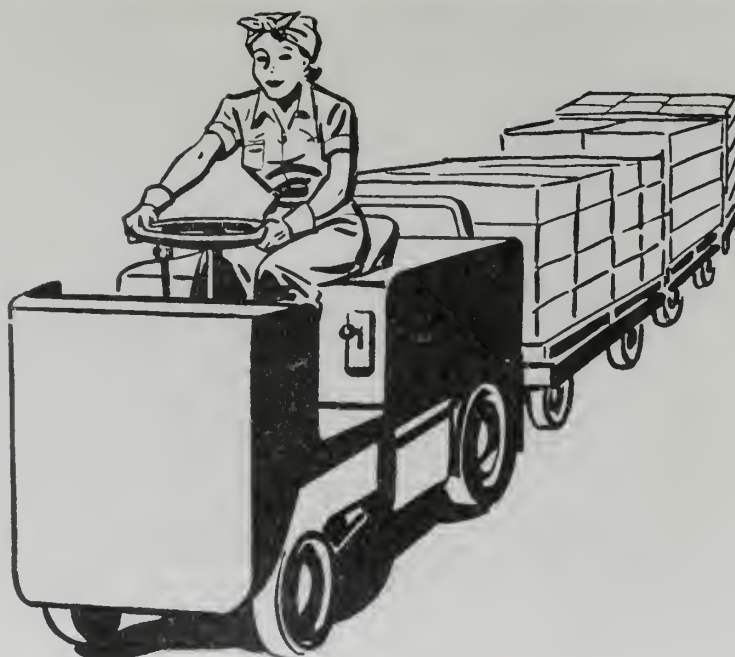


Fig. 6 Tractor-Trailer



Fig. 3. High magnification view of the surface of the specimen.



Fig. 4. Low magnification view of the surface of the specimen.



Fig. 7 Special Power Truck

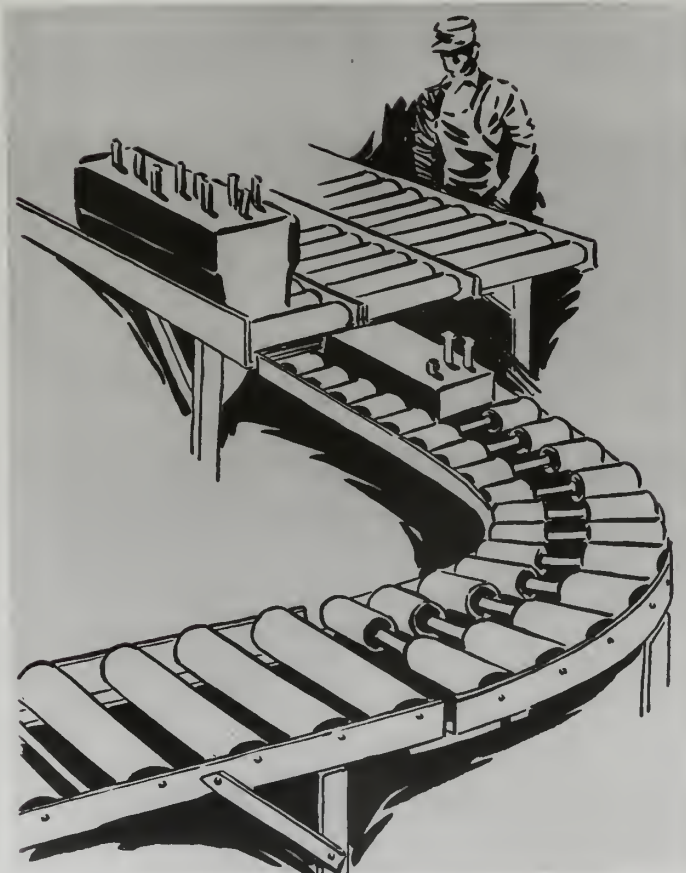


Fig. 8 Roller Conveyor

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1875-1876. 1875-1876. 1875-1876.

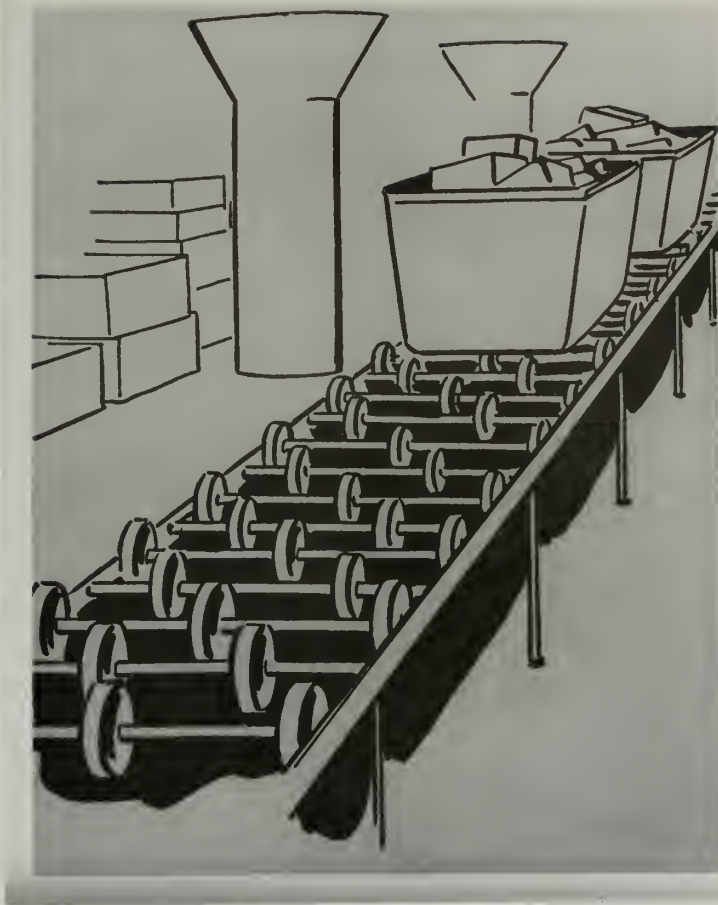


Fig. 9 Wheel Conveyor



Fig. 10 Chute



Figure 1. (a) Schematic diagram of the experimental setup. (b) Photograph of the experimental setup.



Figure 2. (a) Schematic diagram of the experimental setup. (b) Photograph of the experimental setup.

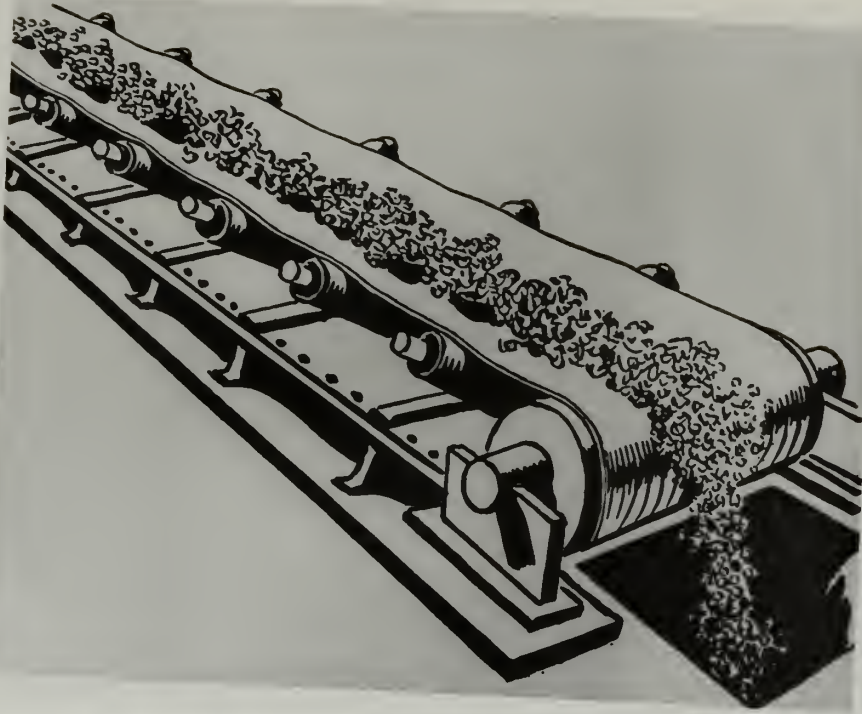


Fig. 11 Belt Conveyor



Fig. 12 Apron Conveyor

1950-1951 12th 42 100%

1950-1951 12th 42 100%



Fig. 13 Pusher Bar Conveyor

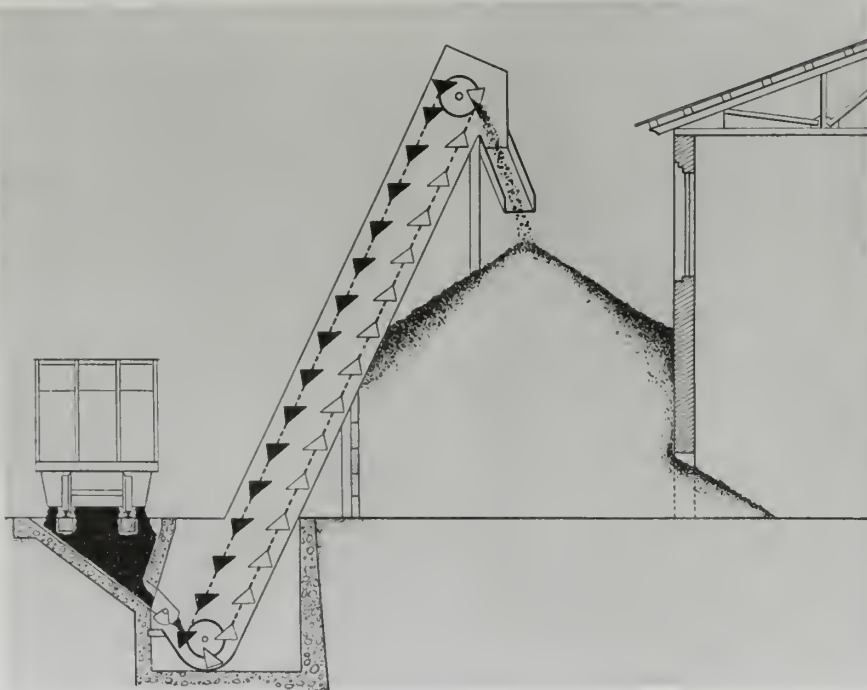


Fig. 14 Bucket Conveyor



Figure 1. (a) Schematic of the experimental setup.



Figure 2. (a) Schematic of the experimental setup.



Fig. 15 Independent Track Carriers

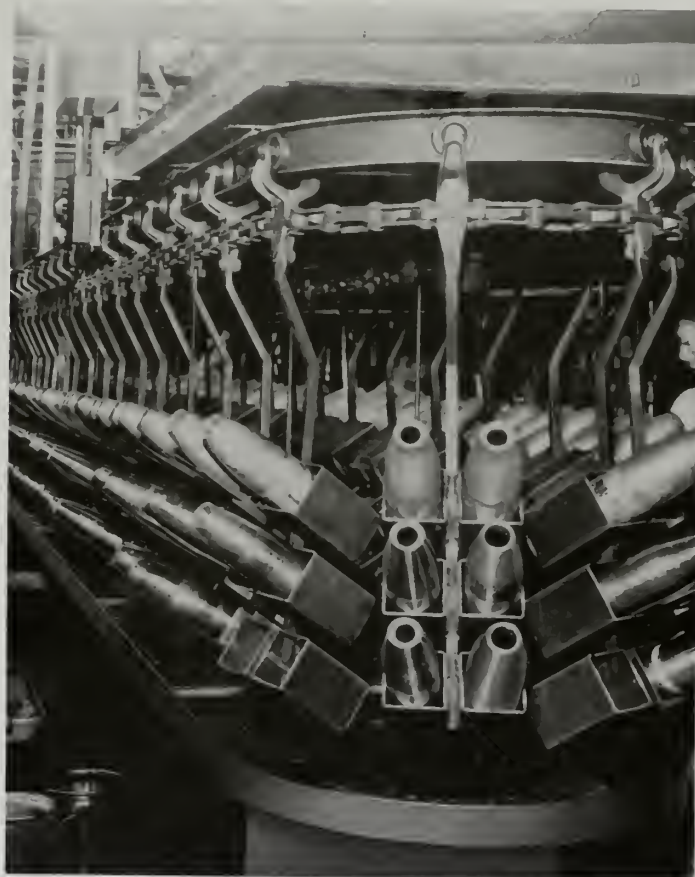


Fig. 16 Chain Conveyor



Fig. 1. Schematic diagram of the experimental setup.



Fig. 2. Schematic diagram of the experimental setup.



Fig. 17 Platform Elevator

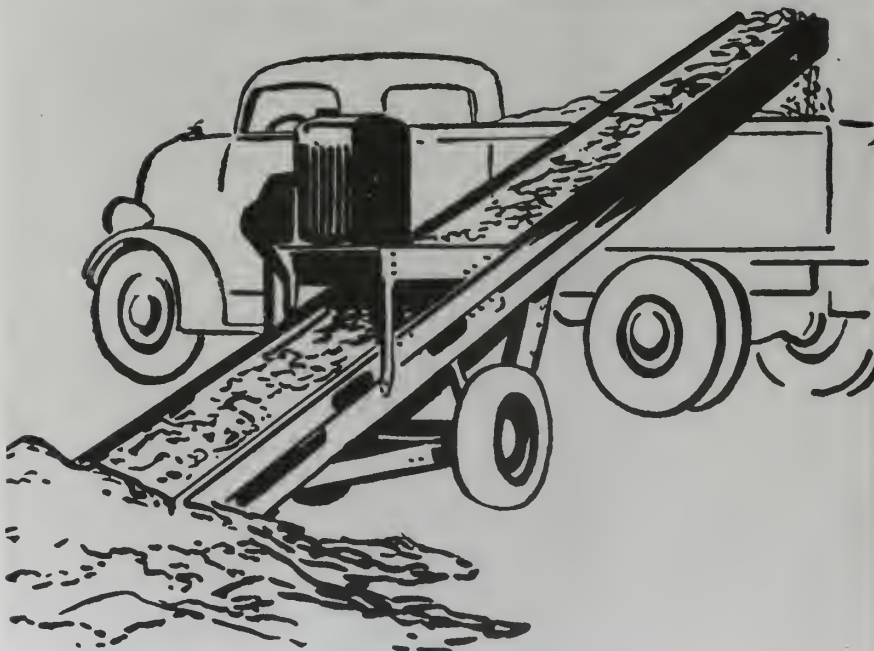


Fig. 18 Portable Conveyor

Figure 1. Schematic diagram of the experimental setup.

Figure 2. Schematic diagram of the experimental setup.

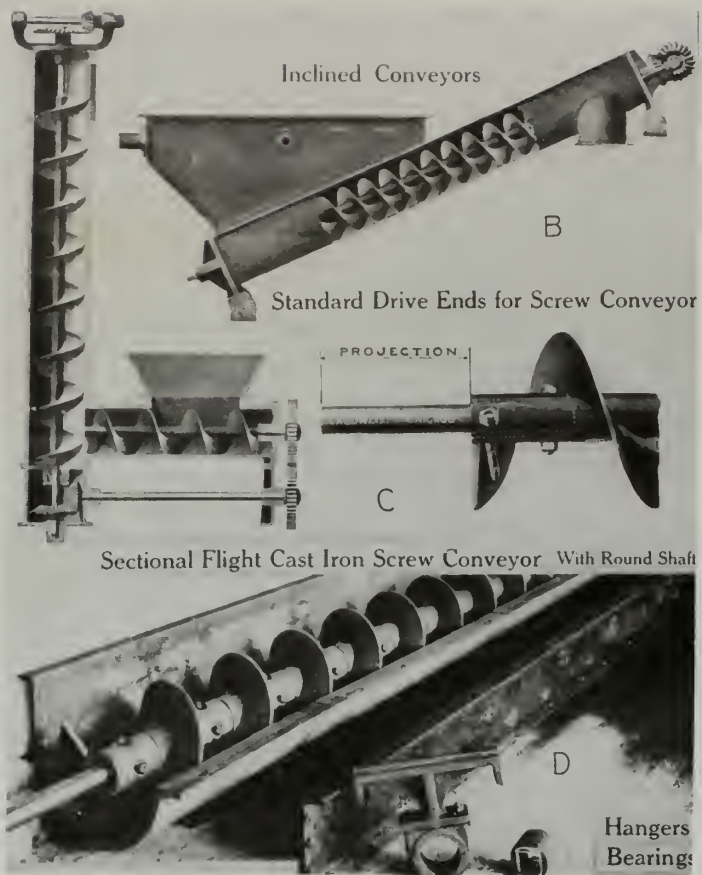


Fig. 19 Special Conveyor



Fig. 20 Bridge Crane

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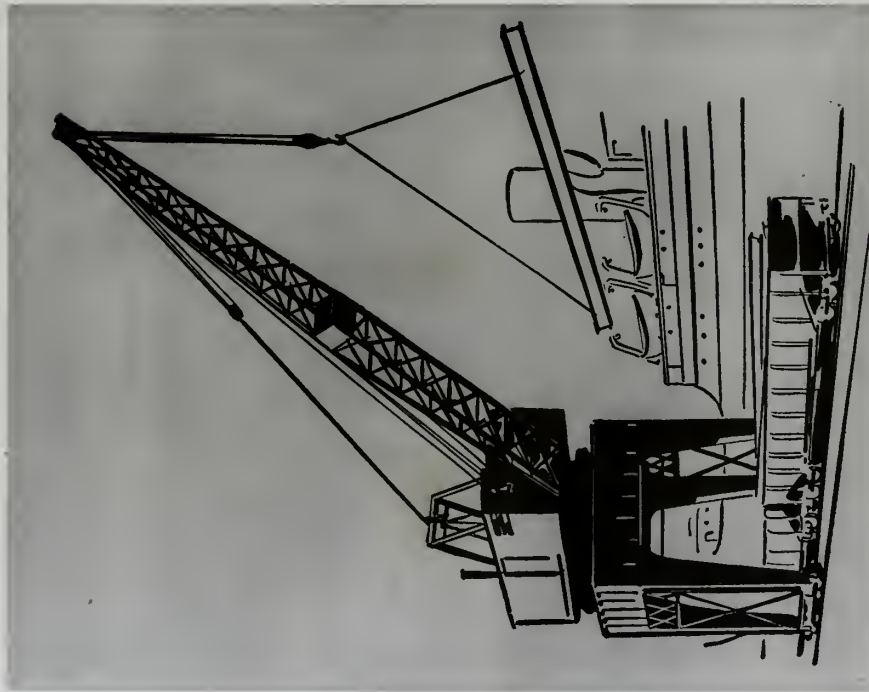


Fig. 21 Boom Crane

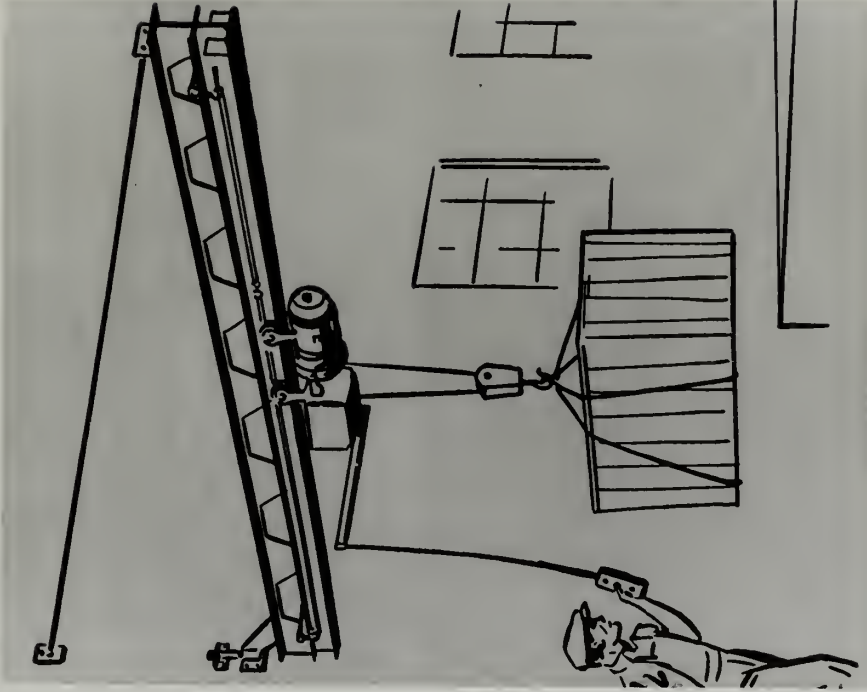


Fig. 22 Jib Crane

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Fig. 23 Fixed Position Hoist

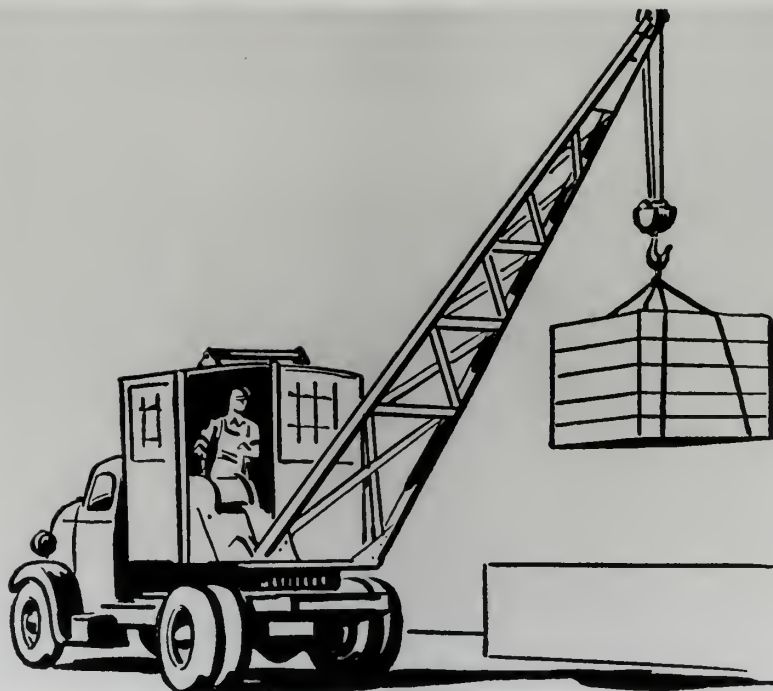


Fig. 24 Portable Crane



Figure 1. A large, empty rectangular box, likely a placeholder for a drawing or photograph.



Figure 2. A large, empty rectangular box, likely a placeholder for a drawing or photograph.

CLASSIFICATION OF MATERIALS

Materials were separated into three groups:

Bulk

Single Load

Unit Load

Bulk. If a quantity of small pieces assumes the shape of the container into which it is placed, then the material is considered as bulk. This definition is somewhat similar to the definition of the liquid state in Physics.

Two conditions are imposed by this definition: that the size of each piece be small in relation to the size of the container, and that the characteristics of each piece allow for a rough handling.

Single Load. If a piece is to be handled one at a time, and no taking apart is to be done at latter steps of the handling operations, one has the case of single load handling.

Unit Load. (33, 34) Any time a certain number of pieces are temporarily assembled together in such way that loading and unloading are performed once for the whole group, one has the case of a unit load. However, this only happens if the unit is supposed to be disassembled at further stages of the process, even if this is done by the final user of the product.

- - - - -

33- "Unitizing for Material Handling," Southern Power & Industry, vol. 69, no. 7, July 1951, p. 62-66.

34- Modern Material Handling; New Jersey, Edison Storage Battery Division, 1951.

EXAMINATION OF MATERIALS

Materials were separated into three groups:

- 1. Bulk
- 2. Single load
- 3. Unit load

Bulk. If a quantity of small pieces occupies the space of the container into which it is placed, then the material is considered as bulk. This condition is sometimes applied to the definition of the limit state in Germany.

Two conditions are imposed by this definition that the size of each piece be small in relation to the size of the container, and that the characteristics of each piece differ from a single handling.

Single load. If a piece is so handled that it is not in contact with any other piece at the time of its handling, it is considered as a single load. However, this does not mean that the piece is not in contact with other pieces at other times.

Unit load. (20, 21) Any piece a certain number of pieces are permanently assembled together in such way that loading and unloading are performed once for the whole group, and the

the case of a unit load. However, this does not mean that the unit is exposed to the dissipation of forces during the handling, even if this is done by the final user of the product.

22- "Criteria for Material Handling," German Standard DIN 151, 1957, and V. 1957, p. 15-16.

23- "Criteria for Material Handling," German Standard DIN 151, 1957, and V. 1957, p. 15-16.

CLASSIFICATION OF MOVEMENTS

Only two classes of movements could be considered:

Horizontal

Vertical

More classes would be desirable from the standpoint of detail, but the literature surveyed lacked such information.

Horizontal. All movements but the vertical raising or lowering. This denomination includes inclined movements.

Vertical. Moving in an up or down direction.

CLASSIFICATION OF MOVEMENTS

Only two classes of movements could be distinguished:

Horizontal

Vertical

Some classes would be dealing from the standpoint of detail, not the type of movement, and hence motion.

Horizontal. All movements but the vertical motion are

horizontal. This classification includes lateral movements.

Vertical. Moving in or up or down direction.

Some of the movements are not in the vertical plane, but are

horizontal, and some are horizontal, and some are vertical.

Some of the movements are not in the vertical plane, but are

horizontal, and some are horizontal, and some are vertical.

Some of the movements are not in the vertical plane, but are

horizontal, and some are horizontal, and some are vertical.

Some of the movements are not in the vertical plane, but are

horizontal, and some are horizontal, and some are vertical.

Some of the movements are not in the vertical plane, but are

horizontal, and some are horizontal, and some are vertical.

Some of the movements are not in the vertical plane, but are

horizontal, and some are horizontal, and some are vertical.

Some of the movements are not in the vertical plane, but are

horizontal, and some are horizontal, and some are vertical.

Some of the movements are not in the vertical plane, but are

horizontal, and some are horizontal, and some are vertical.

CLASSIFICATION OF SERVICES

Again two classes were considered:

Transportation

Transfer

Transportation. The load arrives at its destination point without any intentional modification introduced during the travel.

Transfer. Here transportation and productive operations are performed simultaneously. For example, packaging, inspection, or any other work units may be done.

CLASSIFICATION OF REVISIONS

Again two classes were distinguished:

Transposition

Deletion

Transposition. The head appears at its destination before
 without any formal modification introduced during the

process.

Deletion. Some transposition and deletion operations
 are performed simultaneously. For example, deleting in-

sertion, or any other word with the same.

APPENDIX A

TABLE I

COMPARISON OF MOVEMENTS AND LOADS APPLICABLE FOR

INDUSTRIAL TRUCKS

INDUSTRIAL TRUCKS Class 1		MOVEMENT										LOAD										SERVICE			
		Horizontal					Vertical					Bulk					Single Load					Transp.	Transfer		
		%					%					%					%								
		L	M	S	L	S	L	M	S	L	M	S	L	M	S	L	M	S							
Hand Trucks	a.No lift	25	25	50	-	-	-	-	-	-	0	0	0	100	(50)	0	0	0	100	(50)	0	100	0	80	20
	b.Lift	0	100	0	0	100	0	0	0	0	0	0	0	0	(100)	0	0	100	(100)	0	0	100	0	66	34
	c.No lift	100	0	0	-	-	-	-	-	-	0	0	0	0	(100)	0	0	100	(100)	0	0	100	0	34	66
Powered Trucks	d.Low lift	62	13	25	0	100	100	0	0	0	0	0	0	0	(37)	0	0	100	(37)	0	0	100	0	78	22
	e.High lift	29	57	13	100	0	100	0	100	0	100	0	0	100	(76)	0	0	100	(76)	0	0	100	0	80	20
	f.Tractor-Trailer	86	14	0	-	-	-	-	-	-	0	0	0	100	(86)	0	0	100	(86)	0	0	100	0	63	37
	g.Special																								

In many cases these percentages refer to a lifted number of cases; consequently see page 50 for the exact number referred to.

THE OFFICE OF BOARDMAN HAS TWO PLANTERS

INTERNET

[illegible]

APPENDIX A

TABLE II

COMPARISON OF MOVEMENTS AND LOADS APPLICABLE FOR

CONVEYORS

CONVEYORS Class 2	MOVEMENT										LOAD						SERVICE	
	Horizontal			Vertical			Bulk			Single Load			Unit Load			Transp.	Transfer	
	%			%			%			%			%					
	L	M	S	L	S	L	L	M	S	L	M	S	L	M	S			
	L	M	S	L	S	L	L	M	S	L	M	S	L	M	S			
a. Roller	50	38	12	66	34	0	(0)	0	0	50	(50)	25	25	(50)	50	25	34	66
b. Wheel	50	33	17	75	25	0	(0)	0	0	50	(34)	0	50	(66)	25	75	43	57
c. Chute	0	0	100	100	0	0	(0)	0	0	0	(0)	0	0	(100)	100	0	100	0
d. Belt	55	27	18	87	13	100	(9)	0	0	25	(36)	0	75	(55)	67	13	50	50
e. Apron	66	34	0	100	0	0	(0)	0	0	100	(66)	0	0	(34)	100	0	75	25
f. Pusher Bar	0	100	0	100	0	0	(0)	0	0	0	(100)	0	0	(0)	0	0	50	50
g. Bucket	-	-	-	100	0	100	(100)	0	0	0	(0)	0	0	(0)	0	0	100	0

In any case these percentages refer to a limited number of cases; consequently see page 50 for the exact number referred to.

TABLE II

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CONSTRUCTION OF THE TABLE

REMARKS

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TABLE II (Continuation)
COMPARISON OF MOVEMENTS AND LOADS APPLICABLE FOR
CONVEYORS

CONVEYORS Class 2	MOVEMENT						LOAD						SERVICE						
	Horizontal %			Vertical %			Bulk %			Single Load %			Transp.	Trans-fer					
	L	M	S	L	S	L	L	M	S	L	M	S	L	M	S				
h. Indep. Track Carriers	58	37	5	100	0	100	0	100	0	0	0	75	(21)	(53)	70	20	10	40	60
i. Chain	83	17	0	94	6			(0)				72	(58)	(42)	10	80	10	15	85
j. Platform Elevators	-	-	-	100	0	0	0	0	0	0	0	75	(100)	(0)	0	0	0	40	60
k. Portable	0	100	0	100	0	0	0	0	0	0	0	100	(100)	(0)	0	0	0	100	0
l. Special																			

In many cases these percentages refer to a limited number of cases; consequently see page 50 for the exact number referred to.

Introduction II

and subsequently a board of directors to oversee the

Date	JACOBI		THERMION		Remarks
	Beam Size	Alkali Beam	Alkali	Ionization	
1951-10-10	10	10	10	10	Beam size 10
1951-10-11	10	10	10	10	Beam size 10
1951-10-12	10	10	10	10	Beam size 10
1951-10-13	10	10	10	10	Beam size 10
1951-10-14	10	10	10	10	Beam size 10
1951-10-15	10	10	10	10	Beam size 10
1951-10-16	10	10	10	10	Beam size 10
1951-10-17	10	10	10	10	Beam size 10
1951-10-18	10	10	10	10	Beam size 10
1951-10-19	10	10	10	10	Beam size 10
1951-10-20	10	10	10	10	Beam size 10
1951-10-21	10	10	10	10	Beam size 10
1951-10-22	10	10	10	10	Beam size 10
1951-10-23	10	10	10	10	Beam size 10
1951-10-24	10	10	10	10	Beam size 10
1951-10-25	10	10	10	10	Beam size 10
1951-10-26	10	10	10	10	Beam size 10
1951-10-27	10	10	10	10	Beam size 10
1951-10-28	10	10	10	10	Beam size 10
1951-10-29	10	10	10	10	Beam size 10
1951-10-30	10	10	10	10	Beam size 10
1951-10-31	10	10	10	10	Beam size 10

APPENDIX A

TABLE III

COMPARISON OF MOVEMENTS AND LOADS APPLICABLE FOR CRANES

CRANES

CRANES Class 3	MOVEMENT						LOAD									SERVICE		
	Horizontal %			Vertical %			Bulk %			Single Load %			Unit Load %			Transp.	Transp. for	
	L	M	S	L	S		L	M	S	L	M	S	L	M	S			
	L	M	S	L	S		L	M	S	L	M	S	L	M	S			
a. Bridge	22	33	45	100	0		(0)	0	0	0	100	0	0	100	0	0	78	22
b. Boom	0	100	0	100	0		(0)	0	0	0	100	0	0	100	0	0	66	34
c. Jib	0	0	100	66	34		(0)	0	0	0	100	0	0	100	0	0	66	34
d. Fixed Position Hoists	-	-	-	100	0		(0)	0	0	0	100	0	0	100	0	0	100	0
e. Portable	45	33	22	100	0		(0)	0	0	0	100	0	0	100	0	0	73	27

In many cases these percentages refer to a limited number of cases; consequently see page 50 for the exact number referred to.

CONTRIBUTION OF BIOLOGICAL AND PHYSICAL FACTORS TO HETEROGENEITY OF BIODIVERSITY

[illegible]

Notes for Tables I, II, and III

1. The letters: L, M, and S stand for: large, medium, and small, and they are defined as follows:

Movement

Horizontal: large - more than 250'
 medium - between 50' and 250'
 small - less than 50'

Vertical: large - more than 3'
 small - less than 3'

Load (any type)

large - more than 200 lb.
 medium - between 50 lb. and 200 lb.
 small - less than 50 lb.

2. Numbers inter-brackets represent the percentages of cases that a given type of load was used in relation to the others.

Numbers without brackets represent the percentages of cases that a given sub-class was used in relation to the others.

Example: Table I, first line: From the total number of cases where hand trucks (no lift) were used:

- (a) 25% involved horizontal distances larger than 250'
 25% involved horizontal distances between 50' and 250'
 50% involved horizontal distances less than 50'
 No vertical motions were performed.
- (b) No bulk material was handled. 50% of the loads

1. The letters: α, β, γ , and δ are used in the following sense, and they are defined as follows:

Horizontal:

Horizontal: α - more than 100
 β - between 50 and 100
 γ - less than 50
 Vertical: α - more than 10
 β - less than 10

Lead (any type)

α - more than 100 lb.
 β - between 50 lb. and 100 lb.
 γ - less than 50 lb.

2. Number of cases in which the hypothesis is true in relation to the observed.

Number of cases in which the hypothesis is true in relation to the observed. The number of cases in which the hypothesis is true in relation to the observed.

Example: Table I, first line from the total number

of cases where the hypothesis is true (100) were used.

- (a) 100 involved horizontal distances between 50 and 100
 100 involved horizontal distances between 50 and 100
 100 involved horizontal distances less than 50
 In vertical distances were horizontal
 In this material was included. 100 of the cases

were of the "single load" type and 50% were of the "unit load" type. Single loads were always (100%) heavier than 200 lb. Unit loads were always of the "medium" weight, i.e. between 50 lb. and 200 lb.

- (c) 80% of the cases involved "transportation"
20% of the cases involved "transfer".

- 3. Data related to "special" groups as: special powered trucks (group 1.g), and special conveyors (group 2.1), was omitted. These groups were defined without any direct relation to a definite type of equipment and the data related to them has no meaning.

There are two "single lead" type and two "double lead" type. The "single lead" type is the "only lead" type. The "double lead" type is the "only lead" type. The "single lead" type is the "only lead" type. The "double lead" type is the "only lead" type.

50 lbs and 100 lbs.

(a) The two most common types of "single lead" type are:

1. The "single lead" type.

2. The "double lead" type.

The "single lead" type is the "only lead" type.

The "double lead" type is the "only lead" type.

The "single lead" type is the "only lead" type.

The "double lead" type is the "only lead" type.

APPENDIX B

TABLE IV

CLASSIFICATION OF DATA

Original Form

Refer- ence	Page	Equip- ment	Movement		Load			Service	
			Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp	Trans- fer
1	5	1a	S		20,000	6,000		x	
1	6	1g	L					x	
1	10	2i	L			L			x
1	12	3e	M	18		L		x	x
1	16	1e	S	3		L		x	
1	20	3e	1,000	32			L	x	
1	21	3a	L			230			x
1	21	2i	L	15		2,300			x
1	24	2d	6,800	24		S			x
1	24	2i	1,650	24		S			x
1	24	2a	3,500	24		S			x
1	27	1e	S	4			L	x	
1	31	2a	S				L		x
1	34	1e	M	3			L	x	
1	34	2b	S				M		x
1	35	1f	L				7,500	x	
1	35	3a	S	15		6,000			x
1	37	3e	S	8		7,715		x	
1	37	3e	M	8		L		x	
1	38	3e	S	148		4,000		x	
1	39	1e	180	4		L			x
1	41	1e	M	12			4,000	x	
1	41	11e	M	12			2,000	x	
1	41	1e	M	16			4,000	x	
1	41	1e	M	12			4,000	x	
1	43	2j	-	8			1,000		x
1	44	1e	L	8			3,500		x
1	45	1e	M	8			10,000	x	
1	45	1d	L	2			20,000	x	
1	47	1e	M	6			L	x	
1	48	1b	50	2			2,600	x	
1	49	3a	L	20			15,000	x	
1	49	1e	L	L			15,000	x	
1	49	1d	L	S			18,000	x	
1	50	1e	L	18			L	x	
1	52	1e	M	20			6,000	x	

1 - Material Handling Institute, Inc., Modern Methods of Materials Handling; N. Y., Prentice-Hall, Inc., 1951.

TABLE IV (Continuation)

CLASSIFICATION OF DATA

Original Form

Refer- ence	Page	Equip- ment	Movement		Load			Service	
			Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp	Trans- fer
1	54	1e	M	17.5			15,000	x	
1	56	1d	L	1			4,000	x	
1	58	2h	L	-			M	x	
1	60	1e	M	3			L		x
1	61	2j	-	30			500		x
1	62	1e	1,300	12			4,000		x
1	67	2b	1,000	8			S	x	
1	67	2d	15	6			S	x	
1	69	2b, 2d	3,200	50			S	x	
1	71	2a, 2d	1,000	3			80		x
1	74	1e	M	8			500	x	
1	74	1a	30	20		300		x	
1	76	1e	S	3			2,000	x	
1	77	1e	1,390	18			4,000	x	
1	78	1e	S	6			2,400	x	
1	78	1d	S	S			2,400	x	
1	79	1e	M	15			4,000	x	
1	80	2h	60	-			L		x
1	81	2h	L	-			M	x	
1	83	2i	M	-		S		x	
1	84	1f	600	-		1,500		x	
1	85	1e	M	5	4,150				x
1	87	2h	100	-	L				x
1	88	2h	L	-	L				x
1	90	2h	4,100	-	600				x
1	93	1g	1,000	-	950			x	
1	93	1g	1,000	-	5,000			x	
1	97	1e	200	4	L			x	
1	98	2h	L	30	L				x
1	100	2j	-	3			L	x	
1	102	2h	L	15			6,000	x	
1	104	2b, 2d	70	-		S			x
1	115	3a	S	8			10,000	x	
1	117	1e	900	12			8,000	x	
1	118	3e	300	30		L		x	
1	121	3a	M	20			3,300	x	
1	125	3e	M	12			6,000	x	

1 - Ibid.

[illegible]

TABLE IV (Continuation)

CLASSIFICATION OF DATA

Original Form

Reference	Page	Equip-	Movement		Load			Service	
			Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp.	Transfer
1	132	1e	M	4			3,000	x	
1	134	1e	M	8			1,200	x	
1	137	2h	M	10			2,000		x
1	137	1e	M	6			2,000	x	
1	139	2h	M	-			L		x
1	140	3d	-	18		4,000		x	
1	140	3a	S	12		4,000		x	
1	143	2h	M	12		500			x
1	144	1e	S	12		3,200		x	
1	149	2h	230	5	750				x
1	150	2h	1,630	-			L		x
1	152	2h	L	12			4,000	x	
1	158	1e	L	-			2,360		x
1	161	1d	M	S		25,000			x
1	163	1f	900	-			L		x
1	163	3e	900	L			2,000		x
1	163	1c	900	-			6,000		x
1	164	1e	M	6			5,000	x	x
1	166	1d	L	1			30,000	x	
1	169	1f	200	-			L		x
1	171	3c	10	12		1,000		x	
1	171	3a	25	12		1,000		x	
1	171	2h	30	12		1,000		x	
1	173	2k	M	10		400		x	
1	173	1e	M	10		400		x	
1	175	1e	250	L		400		x	
1	176	1e	M	11		2,000		x	
1	178	1e	S	12		L		x	
1	179	1e	M	12			3,000	x	
1	186	2d, 2a	1,500	10			M	x	
1	192	2h	3,000	10		2,000		x	x
1	197	2h	2,030	22			200,000	x	
1	200	3e	1,000	15		4,000			
1	206	1e	M	L		1,200			x
1	209	2i	L	30		L			x
1	211	1f	500	-			15,000		

1 - Ibid.

Year	Month	Day	Time	Location	Remarks	Amount	Balance
1900	Jan	1	10:00	St. Paul	Received from	100.00	100.00
1900	Jan	2	10:00	St. Paul	Received from	100.00	200.00
1900	Jan	3	10:00	St. Paul	Received from	100.00	300.00
1900	Jan	4	10:00	St. Paul	Received from	100.00	400.00
1900	Jan	5	10:00	St. Paul	Received from	100.00	500.00
1900	Jan	6	10:00	St. Paul	Received from	100.00	600.00
1900	Jan	7	10:00	St. Paul	Received from	100.00	700.00
1900	Jan	8	10:00	St. Paul	Received from	100.00	800.00
1900	Jan	9	10:00	St. Paul	Received from	100.00	900.00
1900	Jan	10	10:00	St. Paul	Received from	100.00	1000.00
1900	Jan	11	10:00	St. Paul	Received from	100.00	1100.00
1900	Jan	12	10:00	St. Paul	Received from	100.00	1200.00
1900	Jan	13	10:00	St. Paul	Received from	100.00	1300.00
1900	Jan	14	10:00	St. Paul	Received from	100.00	1400.00
1900	Jan	15	10:00	St. Paul	Received from	100.00	1500.00
1900	Jan	16	10:00	St. Paul	Received from	100.00	1600.00
1900	Jan	17	10:00	St. Paul	Received from	100.00	1700.00
1900	Jan	18	10:00	St. Paul	Received from	100.00	1800.00
1900	Jan	19	10:00	St. Paul	Received from	100.00	1900.00
1900	Jan	20	10:00	St. Paul	Received from	100.00	2000.00
1900	Jan	21	10:00	St. Paul	Received from	100.00	2100.00
1900	Jan	22	10:00	St. Paul	Received from	100.00	2200.00
1900	Jan	23	10:00	St. Paul	Received from	100.00	2300.00
1900	Jan	24	10:00	St. Paul	Received from	100.00	2400.00
1900	Jan	25	10:00	St. Paul	Received from	100.00	2500.00
1900	Jan	26	10:00	St. Paul	Received from	100.00	2600.00
1900	Jan	27	10:00	St. Paul	Received from	100.00	2700.00
1900	Jan	28	10:00	St. Paul	Received from	100.00	2800.00
1900	Jan	29	10:00	St. Paul	Received from	100.00	2900.00
1900	Jan	30	10:00	St. Paul	Received from	100.00	3000.00
1900	Jan	31	10:00	St. Paul	Received from	100.00	3100.00

TABLE IV (Continuation)
 CLASSIFICATION OF DATA
 Original Form

Refer- ence	Page	Equip-	Movement		Load			Service	
			Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp	Trans- fer
1	213	1e	260	10			L		
1	213	1d	S	S			L		
1	216	21	L	-		M			x
1	222	21	3,000	-		M			
1	228	1e	1,100	16			2,000		
1	232	1a	300	-			M		
1	234	1e	L	10			L		
1	236	3a	150	18	L				
1	237	1f	L	-			L		
2	16	2b	700	L		200			x
2	24	3b	M	150		4 to 60T		x	
2	25	3b	M	40		10T		x	
2	28	3c	50	S		1,500		x	
2	47	2d	200			S			x
2	108	21	195	6	15,000			x	
2	108	2g	-	65				x	
2	108	21	25	L				x	
2	118	2d	2,640	20			M	x	
2	118	1e	M	L			3,500	x	
2	135	2a	M	-		650		x	
2	135	3c	28	12			100		x
2	141	21	180	L			100		x
2	141	21	685	L			100		x
2	141	21	1,025	L			100		x
2	141	21	1,710	L			100		x
2	141	21	500	L			100		x
2	141	21	1,560	L			100		x
2	141	21	1,890	L			100		x
2	154	2e	380	-		L			x
2	154	2e	570	-		L			x
2	154	21	1,726	-		L			x
2	154	21	1,460	-		L			x
2	154	21	750	-		L			x

1 - Ibid.

2 - Materials Handling Case Book; New York, McGraw-Hill Book Co., 1951.

Year	Month	Day	Time	Location	Remarks
1900	Jan	1	10:00	San Francisco	Arrived from New York
1900	Jan	2	10:00	San Francisco	Left for New York
1900	Jan	3	10:00	San Francisco	Arrived from New York
1900	Jan	4	10:00	San Francisco	Left for New York
1900	Jan	5	10:00	San Francisco	Arrived from New York
1900	Jan	6	10:00	San Francisco	Left for New York
1900	Jan	7	10:00	San Francisco	Arrived from New York
1900	Jan	8	10:00	San Francisco	Left for New York
1900	Jan	9	10:00	San Francisco	Arrived from New York
1900	Jan	10	10:00	San Francisco	Left for New York
1900	Jan	11	10:00	San Francisco	Arrived from New York
1900	Jan	12	10:00	San Francisco	Left for New York
1900	Jan	13	10:00	San Francisco	Arrived from New York
1900	Jan	14	10:00	San Francisco	Left for New York
1900	Jan	15	10:00	San Francisco	Arrived from New York
1900	Jan	16	10:00	San Francisco	Left for New York
1900	Jan	17	10:00	San Francisco	Arrived from New York
1900	Jan	18	10:00	San Francisco	Left for New York
1900	Jan	19	10:00	San Francisco	Arrived from New York
1900	Jan	20	10:00	San Francisco	Left for New York
1900	Jan	21	10:00	San Francisco	Arrived from New York
1900	Jan	22	10:00	San Francisco	Left for New York
1900	Jan	23	10:00	San Francisco	Arrived from New York
1900	Jan	24	10:00	San Francisco	Left for New York
1900	Jan	25	10:00	San Francisco	Arrived from New York
1900	Jan	26	10:00	San Francisco	Left for New York
1900	Jan	27	10:00	San Francisco	Arrived from New York
1900	Jan	28	10:00	San Francisco	Left for New York
1900	Jan	29	10:00	San Francisco	Arrived from New York
1900	Jan	30	10:00	San Francisco	Left for New York
1900	Jan	31	10:00	San Francisco	Arrived from New York

 $\Delta t = 1$

U - Universal Handicap Card Entry See 7009, Commentary

TABLE IV (Continuation)

CLASSIFICATION OF DATA

Original Form

Refer- ence	Page	Equip-	Movement		Load			Service	
			Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp	Trans- fer
2	154	2i	1,946	-		L			x
2	94	1a	50	-			150	x	x
2	94	1b	60	S			800	x	x
2	94	1c	250	-			2,500	x	x
2	94	1d	750	S			2,500	x	x
2	94	1e	300	L			2,500	x	x
2	94	1f	600	-			12,000	x	x
2	94	3e	250	L			10,000	x	x
2	94	2c	12	15			50	x	
2	94	2b	50	S			12	x	x
2	94	2a	50	L			50	x	x
2	94	2d	150	L			50	x	x
2	94	2e	150	L			50	x	x
2	94	2f	50	L			50	x	x
2	94	2i	150	L			1,200	x	x
2	94	2h	150	L			40	x	x
2	94	2j	-	25			40	x	x
2	172	2i	1,650	40		250			x
2	182	3a	200	10		30,000		x	
2	182	2a	5,800	10		M			x
2	182	2d	1,940	20	L			x	
2	182	2i	1,752	S		L			x
2	182	2i	1,800	40			75		x
2	182	2h	3,875	-		M			x
3	84	2i	475	L			S		x
4	11	2d	80	-		L			x
4	11	2i	M	L		L			x
4	11	2a	M	S		L			x

2 - Ibid.

3-- Darling, F. E., "Traveling Stockrooms Assure Flexible assembly," Factory Management & Maintenance, vol. 108, no. 9, September 1950, p. 84-7.

4 - Cooke, J. L., "Material Handling Equipment," Ice and Refrigeration, vol. 121, no. 1, July 1951, p. 11-2, 54.

Note: All distances are in feet and all load are in pounds.

[illegible]

4357 2

3- Berlin, P. 1. "Traveling Medicine Men in the West", Medical Record, vol. 10, no. 1, p. 10-12.

"The Great Gatsby", by F. Scott Fitzgerald

Note: All telephone calls in West and all land use in country.

APPENDIX B

TABLE V

CLASSIFICATION OF DATA

Intermediate Form

Equipment	Movement		Load			Service	
	Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp.	Trans-fer
No Lift	3			6,000		x	
Hand Truck	50				150	x	x
	300				M	x	
	30			300		x	
Lift	50	2			2,600	x	
Hand Truck	60	3			800	x	x
No Lift	900				6,000		x
Power Truck	250				2,500	x	x
Low Lift	750	3			2,300		
Power Truck	S	3			L		
	M	3		25,000			x
	L	1			30,000	x	
	L	1			4,000	x	
	S	3			2,400	x	
	L	2			20,000	x	
	L	2			18,000	x	
High Lift	S	3		L		x	
Power Truck	S	4			L	x	
	M	3			L	x	
	180	4		L			x
	M	12			4,000	x	
	M	12			2,000	x	
	M	16			4,000	x	
	M	12			4,000	x	
	L	8			3,500		x
	M	3			10,000	x	
	M	6			L	x	
	L	1			15,000	x	
	L	18			L	x	
	M	20			6,000	x	
	M	17.5			15,000	x	
	M	8			L		x
	1,300	12			4,000		x
	M	8			500	x	
	S	8			2,000	x	
	1,390	18			4,000	x	

FEDERAL BUREAU OF INVESTIGATION
DEPARTMENT OF JUSTICE
WASHINGTON, D. C.

EXHIBIT 1

Date	Description	Amount	Balance	Total	Page
1961	100.00	100.00			1
1962	100.00	200.00			2
1963	100.00	300.00			3
1964	100.00	400.00			4
1965	100.00	500.00			5
1966	100.00	600.00			6
1967	100.00	700.00			7
1968	100.00	800.00			8
1969	100.00	900.00			9
1970	100.00	1,000.00			10
1971	100.00	1,100.00			11
1972	100.00	1,200.00			12
1973	100.00	1,300.00			13
1974	100.00	1,400.00			14
1975	100.00	1,500.00			15
1976	100.00	1,600.00			16
1977	100.00	1,700.00			17
1978	100.00	1,800.00			18
1979	100.00	1,900.00			19
1980	100.00	2,000.00			20
1981	100.00	2,100.00			21
1982	100.00	2,200.00			22
1983	100.00	2,300.00			23
1984	100.00	2,400.00			24
1985	100.00	2,500.00			25
1986	100.00	2,600.00			26
1987	100.00	2,700.00			27
1988	100.00	2,800.00			28
1989	100.00	2,900.00			29
1990	100.00	3,000.00			30
1991	100.00	3,100.00			31
1992	100.00	3,200.00			32
1993	100.00	3,300.00			33
1994	100.00	3,400.00			34
1995	100.00	3,500.00			35
1996	100.00	3,600.00			36
1997	100.00	3,700.00			37
1998	100.00	3,800.00			38
1999	100.00	3,900.00			39
2000	100.00	4,000.00			40
2001	100.00	4,100.00			41
2002	100.00	4,200.00			42
2003	100.00	4,300.00			43
2004	100.00	4,400.00			44
2005	100.00	4,500.00			45
2006	100.00	4,600.00			46
2007	100.00	4,700.00			47
2008	100.00	4,800.00			48
2009	100.00	4,900.00			49
2010	100.00	5,000.00			50

TABLE V (Continuation)

CLASSIFICATION OF DATA

Intermediate Form

Equipment	Movement		Load			Service	
	Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp.	Transfer
High Lift Power Truck (continuation)	S	6	L		2,400	x	
	M	15			4,000	x	
	200	4				x	
	M	4			3,000	x	
	M	8			1,200	x	
	M	6			2,000	x	
	S	12		3,200		x	
	L	L			2,360		x
	M	6			5,000	x	x
	M	10		400		x	
	250	L		400		x	
	M	11	4,150	2,000		x	
	S	12		L		x	
	M	12			3,000	x	
	M	L		1,200		x	x
	260	10			L	x	
	1,100	16			2,000	x	
	L	10			L	x	
	M	L			3,500	x	
	300	L			2,500	x	x
	M	5					x
	900	12			8,000	x	
Tractor-Trailer	600				12,000	x	x
	500				1,500	x	
	L				L	x	
	900				L		x
	200				L		x
	600			1,500		x	
	L				7,500	x	
Special Power Trucks	L		20,000			x	
	1,000		950			x	
	1,000		5,000			x	
Roller Conveyor	3,500	24		S			x
	S				L		x
	1,000	8			80		x
	1,500	10			M	x	

TABLE V (Continued)
CLASSIFICATION OF CASES
INVESTIGATED

Classification	Investigation		Case		Total	Percentage
	Number	Percent	Number	Percent		
Motor Vehicle	1,000	100.0	1,000	100.0	1,000	100.0
Tractor-Trailer	1,000	100.0	1,000	100.0	1,000	100.0
Special	1,000	100.0	1,000	100.0	1,000	100.0
Lower Grade	1,000	100.0	1,000	100.0	1,000	100.0
Police Convoy	1,000	100.0	1,000	100.0	1,000	100.0
Other	1,000	100.0	1,000	100.0	1,000	100.0
Motor Vehicle	1,000	100.0	1,000	100.0	1,000	100.0
Tractor-Trailer	1,000	100.0	1,000	100.0	1,000	100.0
Special	1,000	100.0	1,000	100.0	1,000	100.0
Lower Grade	1,000	100.0	1,000	100.0	1,000	100.0
Police Convoy	1,000	100.0	1,000	100.0	1,000	100.0
Other	1,000	100.0	1,000	100.0	1,000	100.0

TABLE V (Continuation)
CLASSIFICATION OF DATA
Intermediate Form

Equipment	Movement			Load		Service	
	Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp	Trans-fer
Roller Conveyor (continuation)	M 50 5,800 M	L 10 S		650 M L	50	x x	x x x
Wheel Conveyor	700 50 3,200 70 S 1,000	L S 50 S		200 S	12 S M S	x x x	x x x
Chute	12	15			50	x	
Belt Conveyor	20 150 1,940 200 2,640 1,500 1,600 500 40 6,800 15	L 20 20 10 50 S 24 6	L	L S S	50 M M S 80	x x x x	x x x x x x
Apron Conveyor	380 570 150	L		L L	50	x x x	x
Pusher Bar Conveyor	50	L			50	x	x
Bucket Conveyor		65	L			x	
Indep. Track Carriers	150 3,875 M M M	L 10 12		M 500	40 2,000 L	x	x x x x

[illegible]

TABLE V (Continuation)

CLASSIFICATION OF DATA

Intermediate Form

Equipment	Movement		Dulk	Load		Service	
	Horiz.	Vert.		Single Load	Unit Load	Transp	Trans-fer
Indep. Track Carriers (continuation)	230	5	750				x
	1,630				L		x
	L	12			4,000	x	
	30	12		1,000		x	
	3,000	10		2,000		x	
	L				M	x	
	60				L		x
	L				M	x	
	100		L				x
	L		L				x
	4,100		600				x
	L	30	L				x
	L	15			6,000	x	
	2,030	22			200,000	x	
Chain Conveyor	L			L			x
	L	15		2,300			x
	1,650	24		S			x
	M			S		x	
	L	30		L		x	x
	L			M			x
	3,000			M		x	
	180	L			100		x
	685	L			100		x
	1,025	L			100		x
	1,710	L			100		x
	500	L			100		x
	1,560	L			100		x
	1,890	L			100		x
	1,726			L			x
	1,460			L			x
	750			L			x
	1,946			L			x
	150	L			1,200	x	x
	1,650	40		250			x
	1,752	S		L			x
	1,800	40			75		x
	M	L		L			x
	475	L			S		x
Platform Elevator		25			40	x	x
		30			500		x

Information from
CLASSIFICATION OF DATA
TABLE 5 (Continued)

[illegible]

TABLE V (Continuation)

CLASSIFICATION OF DATA

Intermediate Form

Equipment	Movement		Load			Service	
	Horiz.	Vert.	Bulk	Single Load	Unit Load	Transp	Trans-fer
Platform Elevator (continuation)		3 8			L 1,000	x	x
Portable Conveyor	M	10		400		x	
Special Conveyor	195 25	6 L	L L			x x	
Bridge Crane	L S L S M S 25 150 200	15 20 8 20 12 12 18 10		230 6,000 4,000 1,000 L 30,000	15,000 10,000 3,300	x x x x x x	x x
Boom Crane	M M	150 40		L 20,000		x x	
Jib Crane	10 50 28	12 8 12		1,000 1,500		x x	
					100		x
Fixed Pos. Hoist		18		4,000		x	
Portable Crane	250 1,000 900 M 1,000 S M S M	L 15 L 18 32 8 8 148 12			10,000 4,000 2,000 L L 7,715 L 4,000 6,000	x x x x x x x x x	x x x

Note: All distances are in feet and all loads are in pounds.

TABLE VI - SUMMARY OF TABLES IV AND V

Equipment	Movement												Load												Serv.																								
	Horizontal						Vert.						Bulk						S. Load							U. Load																							
	L						S						L						M							S						L						M						S					
	L	M	S	L	M	S	L	M	S	L	M	S	L	M	S	L	M	S	L	M	S	L	M	S		L	M	S	L	M	S	L	M	S															
No Lift Hand Truck	1	1	2																															1	4														
Lift Hand Truck	2	2		2																														1	2														
No Lift Power Truck	5	1	2																															2	1														
Low Lift Power Truck	12	24	6	42																														7	36														
High Lift Power Truck	6	1																																9	5														
Tractor-Trailer	3																																	3	3														
Special Power Truck																																																	
Roller Conveyor	4	3	1	4																														6	4														
Wheel Conveyor	3	2	1	3																														4	3														
Chute																																																	
Belt Conveyor	6	3	2	7																															6	4													
Apron Conveyor	2	1		1																															1	1													
Pusher Bar Conveyor		1		1																															1	1													
Bucket Conveyor																																																	
Independent Track Carriers	11	7	1	10																															12	12													
Chain Conveyor	20	4		15																															22	22													
Platform Elevator				4																															3	3													
Portable Conveyor		1		1																																													
Special Conveyor		1	1	2																																													
Bridge Crane																																																	
Boom Crane	2	3	4	8																															2	2													
Jib Crane		2		2																															1	1													
Fixed Position Hoist			3	2																																													
Portable Crane	4	3	2	1																															3	3													

BIBLIOGRAPHY

Books:

Alford, L. P., Bangs, J. R., Hagemann, G. E., Production Handbook; New York, The Ronald Press Co., 1947.

Section 14 of this handbook is restricted to materials handling. Its approach is the usual, i.e.: basic principles, description of equipment, and technical tables, and formulas for specific use.

Barker, C. H., Footlik, I. M., Yarham, C. F., Carle, J. F., Industrial Materials Handling; Cleveland, Ohio, The Lincoln Extension Institute, Inc., 1950.

The whole field of materials handling is analyzed from the equipment point of view. Each type is described, and its characteristics are studied. Tables and formulas for specific cases are presented.

Day, J. B., Material Handling Engineering; School of Industrial Engineering, Georgia Institute of Technology, 1950.

This book follows more or less the classic type of approach, where basic rules are discussed, equipment is described, cost analysis is studied, and tables of technical data are given.

The Electric Industrial Truck Association, Handbook of Material Handling with Industrial Trucks; Philadelphia, The Electric Industrial Truck Association, 1950.

This handbook represents a practical guide for the

analysis of material handling operations, and the application of the unit load method with power operated industrial trucks and accessories.

Hetzel, F. V., Albright, R. K., Belt Conveyors and Belt Elevators; New York, John Wiley & Sons, Inc., 1941.

This book is restricted to belt conveyors, and elevators, as its name indicates. The chapter 15, "When To Use Belt Conveyors," p. 286 compares the performance of belt conveyors against other types of conveyors.

Koshkin, S. J., Modern Materials Handling; New York, John Wiley & Sons, Inc., 1932.

It is a book 20 years old, but still useful, not only as a basis for comparisons, but also as a source of sound principles and concepts.

Mallick, R. W., Caudreau, A. T., Plant Layout; New York, John Wiley & Sons, Inc., 1951.

This book has two chapters, (about 50 pages) devoted to materials handling in general. As a book specially designed to Plant Layout, the materials handling problem is well-covered.

Potts, M. W., Materials Handling Equipment; New York, Pitman Publishing Corporation, 1946.

This book is devoted to defining, describing, and presenting the application of a number of standard types of materials handling equipment.

Material Handling Institute, Inc., Modern Methods of Materials Handling; New York, Prentice-Hall, Inc., 1951.

analysis of material handling operations, and the application of the unit load method with power-operated industrial trucks and accessories.

Wesley, R. V., Alighting, R. L., Belt Conveyors and Their Accessories; New York, John Wiley & Sons, Inc., 1961.

This book is restricted to belt conveyors, and elsewhere, as the name indicates. The chapter is, "How to Use Belt Conveyors," in which the author compares the performance of belt conveyors against other types of conveyors.

Kochman, S. J., Modern Material Handling; New York, John Wiley & Sons, Inc., 1962.

It is a book for the old, but still useful, not only as a basic for comparison, but also as a source of sound principles and concepts.

Willet, R. E., Andrews, A. T., Plant Layout; New York, John Wiley & Sons, Inc., 1961.

This book has two chapters, (about 50 pages) devoted to material handling in general. As a book especially designed to plant layout, the material handling problem is well-covered.

Fott, W. W., Material Handling Equipment; New York, Pitman Publishing Corporation, 1964.

This book is devoted to defining, describing, and presenting the application of a number of standard types of material handling equipment.

Material Handling Institute, Inc., Modern Methods of Material Handling; New York, McGraw-Hill, Inc., 1961.

This is a case book very well illustrated, and very useful for those seeking information about what has been done in the field of materials handling. Most of the cases analyzed in this thesis were found in this book.

Stocker, R. E., Materials Handling; New York, Prentice-Hall, Inc., 1951.

This book is divided into two parts: one related to materials handling principles and the other related to equipment and methods. Both parts are well illustrated.

Urquhart, L. K., Boyce, C. W., The Materials Handling Case Book; New York, McGraw-Hill Book Co., 1951.

This book is a collection of articles published by Factory Management and Maintenance about materials handling. Each article corresponds to a "case" and these cases are classified by companies, type of equipment, and products handled.

American Monorail Catalogue D; Cleveland, Ohio, 1950.

A general catalogue describing equipment.

Wright, R. V., Little, J. G., Augur, R. C., Material Handling Cyclopedia, New York, Simmons-Boardman Publishing Co., 1921.

This book, although old, represents a very valuable reference for those dealing with material handling nomenclature.

Zimmer, G. F., The Mechanical Handling & Storing of Material, London, The Technical Press Ltd., 1932.

This is a treatise in two volumes, covering practically the whole field of material handling.

This is a very good very well illustrated, and very
handsome book, containing about 1000
pages in the field of materials handling. Most of the
cases reported in this book were found in this book.
Author, D. B. Roberts, Springfield, New York, Thomas-
Hall, Inc., 1931.
This book is divided into two parts: one related to
materials handling principles and the other related to equip-
ment and practice. Both parts are well illustrated.
O'Donnell, L. E., 1934, D. B. Roberts, Springfield, New York, Thomas-
Hall, Inc., 1931.
This book is a collection of various articles by
leading engineers and scientists about materials handling.
Each article corresponds to a "case" and these cases are
classified by companies, types of equipment, and practice
involved.
American Society of Mechanical Engineers, 1934, 1935.
A good book containing descriptive equipment.
Wright, H. V., 1934, D. B. Roberts, Springfield, New York, Thomas-
Hall, Inc., 1931.
This book, although old, represents a very valuable
reference for those dealing with material handling equip-
ment.
Wright, H. V., 1934, D. B. Roberts, Springfield, New York, Thomas-
Hall, Inc., 1931.
This is a book in two volumes, covering practically
the whole field of material handling.

Pamphlets:

Anglo-American Council on Productivity, Materials Handling in Industry; London, New York, 1950.

This is a report of an investigation in the U. S. A. made by a group of engineers appointed by the Council, to study the circumstances which have led to the wide application of materials handling aids, and the use of power-driven tools in American manufacturing industry, and the reasons why employers and employees welcome their introduction.

Modern Material Handling; New Jersey, Edison Storage Battery Division, 1951.

This is a bulletin intended to be an elementary and non-technical description of the unit-load method of material handling, the power requirements of industrial trucks, and the characteristics of Edison Nickel-Iron-Alkaline Storage Batteries in industrial-truck operation.

McClelland, W. B., Joint Navy-Air Force Packaging and Materials Handling Seminar; Battle Creek, Michigan, Industrial Truck Division, Clark Equipment Company, 1950.

These proceedings present an extensive cost analysis for selection of materials handling equipment. An actual case is discussed in detail.

Articles:

Cooke, J. L., "Materials Handling Equipment," Ice & Refrigeration, vol. 121, no. 1, July 1951, p. 11-2, 54.

Outline of factors that enter into selection of equipment for materials handling. Industrial trucks, conveyors and pallets are discussed in detail.

Appendix:

See American Council on Technology, Materials

Handling in Industry London, New York, 1960.

This is a report of an investigation in the U. S. A.

made by a group of engineers employed by the Council, to study the circumstances which have led to the application of materials handling aids, and the use of power-driven cranes in American manufacturing industry, and the reasons why employers and employees welcome their introduction.

Modern Material Handling; New Jersey, Edison Station

Power Division, 1951.

This is a booklet intended to be an elementary and non-technical description of the unit-load method of material handling, the power requirements of industrial cranes, and the characteristics of various fixed-from-fixture storage systems in industrial-cranes operation.

Industrial, U. S. A. (1951) (1951) (1951) (1951) (1951)

Materials Handling; New York, Wiley, 1951, 1952, 1953, 1954, 1955.

Chief, Power Division, New York Edison Company, 1950.

These materials present an extensive and complete for selection of materials handling equipment. An actual case is discussed in detail.

Appendix:

Consolidated, U. S. A. (1951) (1951) (1951) (1951) (1951)

Materials Handling, vol. 1, no. 1, July 1951, p. 11-12, 13.

Outline of factors that affect the selection of equipment for materials handling. Industrial cranes, conveyors and rollers are discussed in detail.

Darling, F. E., "Traveling Stockrooms Assure Flexible Assembly," Factory Management & Maintenance, v. 109, no. 9, Sept. 1950, p. 84-7.

The five traveling "stockroom" conveyors used by Kodak for Baby Brownie camera assembly, are described. The advantages of this system are indicated, and the article is well illustrated.

"What Equipment for Positioning," Flow, vol. 7, no. 6, March 1952, p. 59-63.

This is a fully illustrated article describing types and applications of various positioning equipment.

Harder, D. S., "Cut Costs: Push Material Handling," Iron Age, vol. 166, October 18, 1951, p. 91.

The author, vice-president in charge of manufacturing at Ford Motor Co., stresses the need for adequate research and training centers in materials handling. 25% out of every dollar paid for production labor is said to be spent in materials handling.

Loughrey, D. J., "Material Handling for a Modern Open Hearth Furnace Plant," Blast Furnace & Steel, vol. 39, October 1951, p. 1211.

A new steel plant in Pittsburgh, with capacity for 2 million tons of ingots per year, is described from a material handling point of view. It is said that about 2½ tons of material is handled for every ton of steel produced. During the year of 1950, over 90% of the disabling accidents occurred as a result of materials handling operations.

Journal, v. 11, "Traveling Westward Across the
 country," Country Magazine, v. 10, no. 6,
 Sept. 1900, p. 14-15.

The five traveling "bookstore" companies used in Texas
 for their business are mostly, very successful. The other
 four of this system are largely, and the entire is well
 illustrated.

These companies are "bookstore," Book, vol. 1, no. 4,
 March 1900, p. 50-51.

This is a fully illustrated and complete system
 and application of various positioning systems.

London, v. 1, "The Great Book Store,"
Book, vol. 1, no. 1, 1901, p. 14.

The system, also, is a complete and complete
 of book store for, it gives the reader a complete

and complete course in various reading. 80% of
 every book sold for position is said to be sold
 in various reading.

London, v. 1, "The Great Book Store,"
Book, vol. 1, no. 1, 1901, p. 14.

October 1901, v. 1, 1911.

A new book is in "The Great Book Store," with a copy for
 5 copies of books per year, is a complete book

of book of material is included for every one of each year
 book, being the year of 1900, with 100 of the book

bookstore is a result of various reading systems.

"Unitizing for Material Handling," Southern Power & Industry, vol. 69, no. 7, July 1951, p. 62-66.

This is a summary of questions that were presented at a round table discussion at a meeting of the Midwest Materials Handling Society. The answers are given.

"They Pick 'em Up and Lay 'em Down," Time, May 14, 1951, p. 106-2.

A short topic concerned with the progress of the material handling industry. The fact that the U. S. Navy used fork-lift trucks to perform prodigious feats of loading and unloading battle cargo during the World War II, is mentioned.

Wharen, H. S., "Modern Materials-Handling Methods," American Machinist, June 20, 1946, p. 109-140.

This article defines and describes hoists, cranes, conveyors, and industrial trucks. Selection of equipment and safety in handling are briefly mentioned. The article presents a graph comparing the demand for electric and power trucks, according to types, through 23 years.

Wolverhampton, R. B., "Hook Handlers Simplify Heavy Lifts," American Machinist, vol. 93, no. 24, Dec. 1, 1949, p. 86-7.

Description of lifting and handling equipment, made to work from shop hoists cranes; simple principles included in their design are shown.

Note: The following books and articles were not referred to in the text.

"Uniting for material handling," Equipment 1951, 1, 1-2.
Industry, vol. 20, no. 7, July 1951, p. 25-26.
 This is a summary of functions that were presented
 at a round table discussion on a number of the latest
 materials handling devices. The answers are given.
 "They pick up and lay 'em down," Time, May 14, 1951,
 p. 104-5.

A short paper presented with the program at the
 material handling industry. The time was 11:15 AM.
 used for a 15-minute to review problems that are
 in and solving them during the year 1951, is
 included.

Stanton, R. E., "Modern Material-Handling Methods,"
Industrial Engineering, June 20, 1946, p. 109-110.
 This article defines and describes hoists, cranes,
 conveyors, and industrial trucks. Selection of equipment
 and safety in handling are briefly mentioned. Two articles
 present a brief overview of the current for electric and
 power lines, according to type, through 1950.
 Weinstock, A. E., "New handling devices,"
Modern Industrial Engineering, vol. 23, no. 26, Dec. 1, 1949,
 p. 66-7.

Description of lifting and handling equipment, such
 as work from shop hoists cranes; simple principles included
 in their design are shown.

Note: The following books and articles were not referred to
 in the text.

American Society of Tool Engineers, Tool Engineer Handbook; New York, McGraw-Hill Book Co., 1949.

Although presented in a very compact form, the materials handling section of this handbook is very well prepared. A table designed to help in the selection of materials handling equipment is available.

The Flow Directory; Cleveland, Ohio, Flow Magazine, 1952-1953.

This book represents a very useful reference for material handling selection on account of its various lists of equipment and manufacturers. One section is devoted to charts, and technical tables pertinent to specific problems.

Diamond, E. L., "Characteristics of Scrap in Relation to Bulk Handling," Iron & Steel, vol. 164, April 1950, p. 452-462.

The author states that a very great increase in the rate of supply of scrap to large melting furnaces would probably be obtainable only by a departure from the pan method of loading. The influence of the shape of the scrap when fed from chutes is analyzed in an extensive experiment.

Diemer, C. P., "Champion Rivet Eliminates 90% of Man Lifting Jobs," Iron Age, vol. 164, no. 22, Dec. 1, 1949, p. 98-100.

A material handling system using ram trucks, fork trucks, hand lift trucks, scales and hoists, has been set up. Results are analyzed showing savings in time, space and man-hours.

International Society of Tool Engineers, Tool Engineers

Handbook, New York, McGraw-Hill Book Co., 1949.

Although presented in a very compact form, the

materials handling section of this handbook is very well

presented. A table devoted to help in the selection of

materials handling equipment is available.

The first directory: Cleveland, Ohio, Ohio Division,

1952-1953.

This book represents a very useful reference for

materials handling section on account of the various

lists of equipment and manufacturers. One section is

devoted to charts, and technical tables pertinent to ap-

plied problems.

Diamond, J. L., "Characteristics of Supply in Relation

to Bulk Handling," Iron & Steel, Vol. 104, April 1953,

1, 450-452.

The author states that a very great increase in the

rate of supply of supply is being being achieved through

gradually be obtainable only by a decrease from the per-

centage of loading. The following of the shape of the curve

when the time factor is analyzed in an extensive report.

1953.

Diamond, J. L., "Characteristics of Supply in Relation

to Bulk Handling," Iron & Steel, Vol. 104, May 1, 1953,

1, 450-452.

A material handling system using two modes, first

mode, hand lift trucks, cranes and cranes, has been

up. Materials are analyzed showing savings in time, space

and man-hours.

"How 10 Companies Used Better Handling to Save Manpower, Speed Production," Factory Management & Maintenance, vol. 109, no. 5, May 1951, p. 86-112.

The article shows various forms of modern handling systems. A chart is given to explain how ten different companies solved their specific problems, and the advantages introduced. Each case is illustrated and described in detail.

"What Kind of Shipping Container?," Flow, vol. 7, no. 6, March 1952, p. 110-129.

More than 50 different types of containers are mentioned. Accompanying photographs show how these containers are being used in modern industries.

Hanson, B., "Cutting the Cost of Materials Handling," Management Review, vol. 40, September 1951, p. 549.

A program was designed to provide the various operating divisions of a company with a uniform approach to materials handling cost improvement.

Hussbaum, A. I., "Special Equipment Handles Heavy Components," American Machinist, vol. 99, no. 9, May 1, 1950, p. 76-77.

This article shows how to handle heavy and awkwardly shaped materials.

Pantas, L. J., "Speeding Production Through Modern Materials Handling," Management Review, vol. 40, February 1951, p. 61

An over-all discussion of material handling problems.

"New 10-Component Used Waste Handling in New York"

Journal, "Waste Handling," January 1961, p. 111.

1961, vol. 10, no. 6, p. 111.

The article shows various forms of waste handling systems. A chart is given as Appendix A for the various companies which handle waste, and the various types of waste. This chart is illustrated and described in detail.

"The Kind of Waste Handling," p. 111, vol. 10.

1961, vol. 10, no. 6, p. 111.

How can we better types of containers be made. Improving packaging show the three containers are used in modern industries.

James, L., "The Kind of Waste Handling,"

Journal, "Waste Handling," vol. 10, no. 6, p. 111.

The program was designed to provide the various types of waste of a company with a better approach to materials and cost improvement.

James, L., "The Kind of Waste Handling,"

Journal, "Waste Handling," vol. 10, no. 6, p. 111.

1961, vol. 10, no. 6, p. 111.

This article shows how to handle waste and materials in a better way.

James, L., "The Kind of Waste Handling,"

Journal, "Waste Handling," vol. 10, no. 6, p. 111.

1961, vol. 10, no. 6, p. 111.

The article shows how to handle waste and materials in a better way.

The author suggests a safety factor of 3 to 1 for stresses in the floor slab, that are imposed by a truck in operation.

Potts, M. W., "Watch Those Handling Costs!," Management Review, vol. 40, November 1951, p. 681.

A short topic on material handling possibilities. The author says that an efficient system must be capable of producing a three-way saving; in time, money, and space.

SOURCE OF ILLUSTRATIONS

Figure

- 1 - Potts, M. W., Materials-Handling Equipment; New York, Pitman Publishing Corp., 1946, p. 62.
- 2 - Potts, M. W., op. cit., p. 70
- 3 - Potts, M. W., op. cit., p. 107
- 4 - Potts, M. W., op. cit., p. 117
- 5 - Potts, M. W., op. cit., p. 109
- 6 - Potts, M. W., op. cit., p. 121
- 7 - The Frank C. Hough Co., Hough Payloader Model HA; (Catalogue)
- 8 - Potts, M. W., op. cit., p. 9
- 9 - Potts, M. W., op. cit., p. 20
- 10 - Potts, M. W., op. cit., p. 137
- 11 - Potts, M. W., op. cit., p. 14
- 12 - Potts, M. W., op. cit., p. 12
- 13 - Potts, M. W., op. cit., p. 52
- 14 - Hoshkin, S. J., Modern Materials Handling; New York, John Wiley & Sons, Inc., 1932, p. 424
- 15 - Material Handling Institute, Inc., Modern Methods of Materials Handling; New York, Prentice-Hall, Inc., 1951, p. 58
- 16 - Mechanical Handling Systems, Inc., (Bulletin No. G-4)
- 17 - Potts, M. W., op. cit., p. 60
- 18 - Potts, M. W., op. cit., p. 16
- 19 - Hoshkin, S. J., op. cit., p. 273

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- 20 - Potts, M. W., op. cit., p. 79
 - 21 - Potts, M. W., op. cit., p. 80
 - 22 - Potts, M. W., op. cit., p. 88
 - 23 - Chisholm-Moore Hoist Corp., (Catalogue No. 1952)
 - 24 - Potts, M. W., op. cit., p. 86
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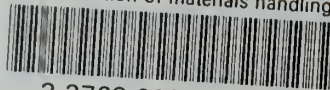
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